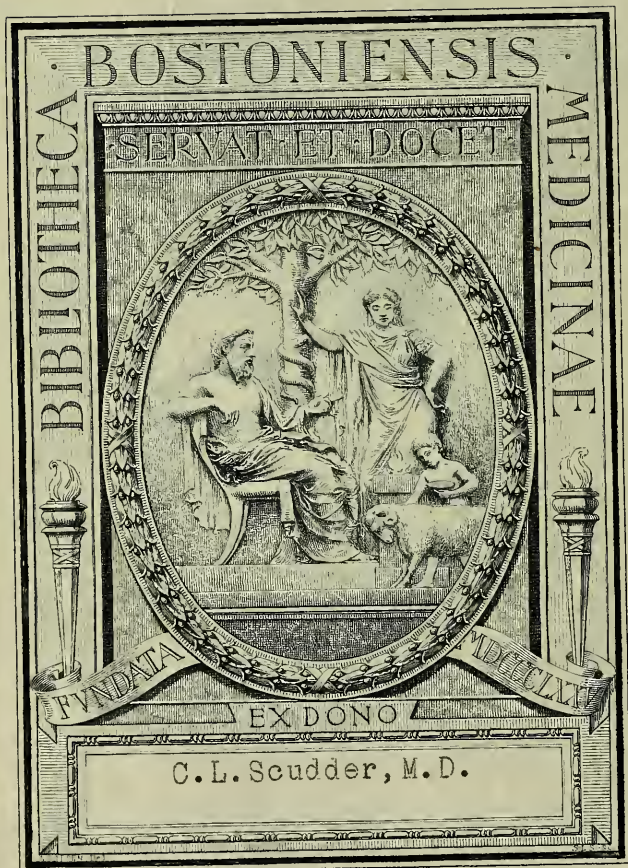






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RECENT FRACTURES  
AND  
INTERNAL DERANGEMENTS OF  
THE KNEE-JOINT

LECTURES AND ESSAYS  
BY  
WILLIAM H. BENNETT, F.R.C.S.

---

ON THE USE OF MASSAGE AND EARLY PASSIVE  
MOVEMENTS IN RECENT FRACTURES AND OTHER  
COMMON SURGICAL INJURIES, AND THE TREATMENT OF  
INTERNAL DERANGEMENTS OF THE KNEE-  
JOINT.

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IN RECENT FRACTURES

AND OTHER COMMON SURGICAL INJURIES

AND THE TREATMENT OF

INTERNAL DERANGEMENTS OF THE  
KNEE-JOINT

THREE CLINICAL LECTURES DELIVERED AT ST. GEORGE'S HOSPITAL

BY



WILLIAM H. BENNETT, F.R.C.S.

SENIOR SURGEON TO ST. GEORGE'S HOSPITAL  
MEMBER OF THE COURT OF EXAMINERS, ROYAL COLLEGE OF SURGEONS  
OF ENGLAND, ETC.

Reprinted, after revision, from THE LANCET

WITH 12 ILLUSTRATIONS

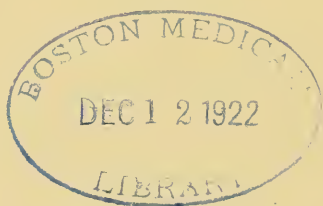
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## AUTHOR'S NOTE

THE following lectures on the use of massage and early movements in Recent Fractures are, with a few verbal alterations, and the addition of three illustrations, published as they originally appeared in the *Lancet*. The lecture on Internal Derangements of the Knee-joint is conveniently included in this volume on account of the value which is claimed for the treatment by temporary rest and massage. The lecture, however, is not limited to this point, but deals with the whole subject, including the treatment by operation. The remarks printed in the smaller type have been added since the appearance of the Lecture in the *Lancet*. Publication in the present form has been deferred with a view to increasing the number of cases under consideration. These now amount to more than 250, and the author is unaware that a critical consideration of so many successive cases has been forthcoming—at all events in recent times.

W. H. B.

1 CHESTERFIELD STREET, MAYFAIR, LONDON :

October 1900.



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## LECTURE I <sup>1</sup>

### THE USE OF MASSAGE AND EARLY MOVEMENTS IN RECENT FRACTURES AND OTHER COMMON INJURIES

MORE than two years ago I called attention to the use of massage in recent fractures (see Appendix), a treatment which had previously received too little attention in this country. After having had some experience of it I then came to the conclusion that, rationally practised, this treatment was probably the best method which could be used in the majority of ordinary fractures, both simple and compound, when the circumstances of the practitioner and of the patient permitted its adoption. The result of that communication was, I believe, a considerable increase in the use of the method. It has been employed freely in St. George's Hospital with excellent results. Latterly, however, there has been some falling off in its use—not because there is anything wrong in the principle of the method or with its results, but because it is at times

<sup>1</sup> Delivered on January 30, and published in the *Lancet* June 2, 1900.

difficult to keep the necessary number of dressers, who of course are constantly changing, sufficiently instructed in the details to enable it to be safely carried out. I have, therefore, thought that it might be useful to devote some time to a practical description of the way in which the treatment should be applied.

I do not propose to confine my remarks altogether in these lectures to massage in fracture, as I think it will be useful to deal generally also with the legitimate use of rational massage in common surgical injuries. In other words, I shall try to say something useful about the treatment of recent fractures, of dislocations, and of sprains and bruises by the same means. It is possible that I may be able to say something useful about the treatment of each of these varieties of injury ; at all events, I hope the time spent in considering the matter will not be entirely wasted.

#### THE USE OF MASSAGE AND EARLY MOVEMENT IN RECENT FRACTURES

It is well known that the real difficulties and disappointments in cases of fracture, supposing they are treated in the ordinary way, often commence after the union has taken place and the patient begins to think of getting about. There are, of course, initial difficulties in connection with the 'setting' of the

bones and in the subsequent keeping of the fragments properly in place ; but these, as a rule, cause no great trouble provided they are intelligently met. The difficulties in the later stages are mainly pain and stiffness, which frequently require a long and trying course of massage and passive movement before the patient is able to get about with comfort or to follow his occupation, and which sometimes lead to permanent crippling. In the case, for example, of a fracture of the leg treated in the ordinary way by having been placed in splints or in plaster-of-Paris, or in some other contrivance of that kind, for a long period, say from six to eight weeks, you will find that when the splint, of whatever kind it may be, is taken off and the patient begins to walk about or tries to walk about, complaint is frequently made of intolerable pain about the ankle and sometimes across the sole of the foot. The ankle is stiff, the knee may also be stiff, and the muscles are wasted, so that the leg may be little more than bone and skin. Supposing, however, that the case has been treated rationally by massage from the beginning, you will find that the patient is afflicted with none of these troubles ; the ankle is not stiff, there is no pain such as I have mentioned, and the muscles are not wasted, because when massage and early movements are used they are prevented from shrinking ; in fact, when the patient begins to get about the ankle is free

and supple, and the muscles are practically in the same condition as those of the sound limb. These are obvious and great advantages. The reasons of the discomfort which patients suffer when the treatment has been conducted upon classical lines are easily explained. The stiffness is due to the fact that in consequence of the limb having been placed in an immovable splint for a long period the joint included in the splints becomes, as a matter of course, temporarily stiff. If, for example, a perfectly healthy ankle-joint were put into a plaster-of-Paris splint for six weeks or two months it would be found upon the removal of the splint that the natural mobility of the joint could only be obtained at the expense of pain and some discomfort. In fracture the stiffness is of course infinitely increased by the adhesions of the soft parts around the seat of the lesion.

A noteworthy pain in fracture of the leg is that which shoots downwards from the seat of the fracture along the back of the leg, behind the inner malleolus, and thence into the sole of the foot. This pain is sometimes most acute, and at times leads to permanent crippling: it is due to neuritis produced by the parts about the fracture becoming matted at the level of the injury; this matting sometimes involves the posterior tibial nerve, and so gives rise to the neuritis. This condition is no imaginary one, since I have proved it by dis-

section.<sup>1</sup> The result of this condition is that when the patient begins to try to use the limb after the mere stiffness due to the splints has been overcome, any free movement of the foot causes a dragging upon the adherent nerve, so that an intense neuralgic pain is caused. So acute is this pain in some cases that it prevents the patient proceeding further with attempts to get better movement. People are therefore sometimes seen walking with stiff ankles after fractures of the leg which have been treated by persistent splinting, not because the stiffness cannot be overcome, but because the pain on movement of the ankle is so great that they are unable to bear the necessary manipulation. All this trouble is preventable by the use of intelligent massage and movement in the early stages of fracture.

In the early stage of fractures the main difficulty is, as I have already said, connected with the setting of the bones, the difficulties arising in this respect being mainly three. One is the ordinary nervousness of the patient, which, of course, can only be overcome by tactful management or by the administration of an anæsthetic; the second is connected with the direction or other peculiarity of the fracture; and the third difficulty arises from muscular spasm, the result, no doubt, either of irritation of the muscles by sharp edges of bone or of direct laceration of

<sup>1</sup> The *Lancet*, February 5, 1898, p. 359. (See Appendix, p. 89.)

## 6 MASSAGE AND MOVEMENTS IN FRACTURES

the muscles themselves, which in consequence become hypersensitive and excitable. I know of nothing more difficult to relieve under ordinary

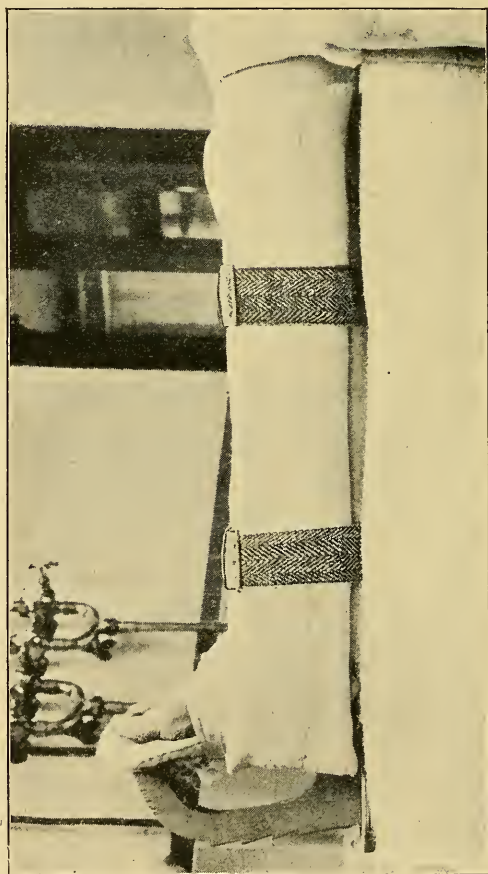


FIG. 1.—MASSAGE IN RECENT FRACTURE OF THE LEG

STAGE 1: *The Fracture set.*—The limb is secured on a back-splint, with a slightly oblique foot-piece, by bandages at the ankle and knee. Side-splints fixed by webbings or straps complete the fixation of the fracture.

circumstances than the muscular spasm which comes on after the injury in some cases of fracture. Not only is it painful to the patient, but the constant muscular contractions frequently render the retention

of the fragments in proper position almost impossible.

In the old times—and with some people it is even the custom now—it was sought to overcome this spasm by tenotomy; and since spasm is more commonly met with in the muscles of the calf than elsewhere, division of the tendo Achillis was the operation most frequently performed with this object, because it was thought that division of the tendon would for the time being paralyse the gastrocnemius and soleus, and would permit of the proper adjustment and retention in position of the fragments which could not be otherwise accomplished. It is not unusual after the reduction of a fracture with or without the aid of an anæsthetic—we will, for example, take the case of the leg—to find when the patient recovers consciousness that uncontrollable spasm occurs; the pain is acute, muscular contraction is inevitable, and if the fracture is at all oblique the displacement recurs. Spasm of this kind is more efficiently controlled by massage than by any other plan, excepting perhaps prolonged anæsthesia by ether or narcotism by opium, alternatives which are obviously undesirable in a general way.

Assuming that massage in these cases of recent fracture is right—as I have no doubt it is—the next point for our consideration is the method of its application. There are, roughly, three stages in the

process, and each of these stages effects certain purposes. Naturally, the first thing in every fracture is to 'set' the broken bones, by which I mean

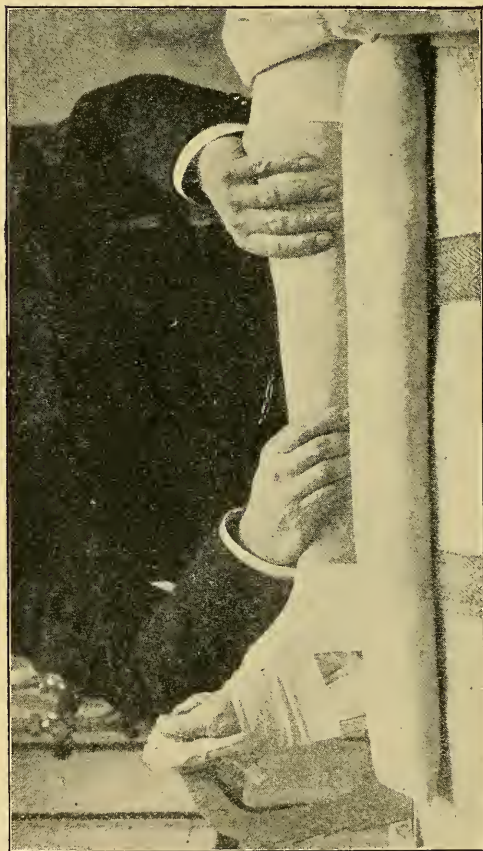


FIG. 2.—MESSAGE IN RECENT FRACTURE OF THE LEG

STAGE 2: *Immediate smooth rubbing*.—Commences at any time, the sooner the better, after the fracture has been 'set.' The straps fixing the side-splints are unfastened and the splints are allowed to fall away from the limb. The knee is then steadied by one hand of the manipulator, whilst smooth gentle rubbing from the foot upwards is effected by the other hand, which is made to grasp as much of the circumference of the limb as possible. The time required is from five to ten minutes. The objects are the relief of muscular spasm and rapid absorption of effused blood &c. At the end of this stage the side-splints are replaced, leaving the parts in the condition shown in fig. 1.

placing them in their proper positions. Nothing short of accurate replacement of the fragments in their proper position should be regarded as a satisfactory 'setting.' *The primary point, therefore,*

*to be borne in mind in every case of fracture is that too much trouble cannot be taken in the first instance in getting the bones into position.* With regard to the plan of fixing fractured bones in position by the use of screws, nails, pegs, wire, &c., I propose to say nothing here. The method is under certain conditions a good one, but it obviously cannot be freely adopted by the ordinary practitioner, although it may produce excellent results in the practice of some of us.<sup>1</sup>

Returning from this digression to the method of applying massage, let us suppose that this man before you has a broken leg, somewhere below its middle. He has come at once to the hospital, and the fracture has been what is commonly called 'set'; and as he has come to a great hospital we will suppose it has been properly set. There is a good deal of swelling about the fracture; there is also a certain amount of muscular spasm. He complains so much of the spasm that unless something is done he can hardly lie quiet, and he certainly cannot sleep or feel comfortable. The ordinary method under such circumstances is to give an hypodermic injection of morphia, or, if the bones are not in precise apposition, to give an anæsthetic if that has not already been done. You will, however, find that unless the bones are grossly out of place—in

<sup>1</sup> See *Present Position of the Treatment of Simple Fractures of the Limbs*.

which case you must at once rectify the defect—gentle rubbing over the fracture, merely a smooth upward movement of the hand which grasps as much

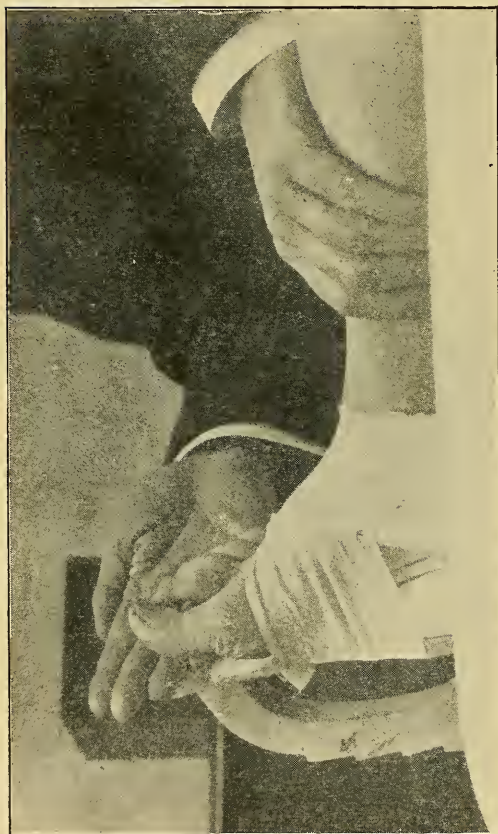


FIG. 3.—MESSAGE IN RECENT FRACTURE OF THE LEG

STAGE 3: *Commencement of Internal Massage*.—After preliminary smooth massage, as described in Stage 2, one hand of the manipulator is insinuated between the toes of the affected side and the foot-piece of the splint (fig. 3). Dorsal flexion is then effected as much as possible by rotating the hand forwards and downwards (*vide* fig. 4). This movement is repeated from five to ten times, the fracture being steadied by the grasp of the other hand of the manipulator. The date of the commencement of this stage may be any time after the second day. The objects are, early slight movement of the flexor tendons at the back of the ankle to prevent adhesions. Movement of the toes separately instead of *en bloc* may be substituted at discretion. At the end of this stage the side-splints are replaced as in fig. 1.

of the circumference of the limb as possible, will in a very few minutes, in the majority of cases, practically relieve all spasm. You will sometimes find people who are suffering from spasm to such an extent that they

cry out with the pain, and who are certainly unable to get any peaceful rest, after a few smooth passages of the hand over the damaged part settle down

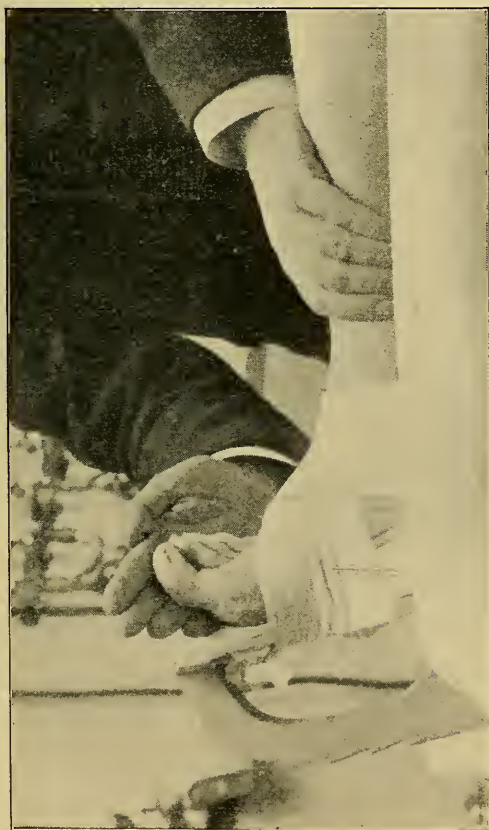


FIG. 4.—MASSAGE IN RECENT FRACTURE OF THE LEG  
(See fig. 3)

comfortably; in some cases they will actually fall asleep whilst the rubbing is proceeding. This manipulation, however, must be done in the right way—that is to say, with the flat of the palm of the hand

grasping the limb very smoothly and uniformly in the way I show you (*vide* fig. 2). You need not be in the least degree afraid of passing the hand over the fracture if it is done properly. Patients do not resent the pressure at all—in fact, they rather like it, as some of you know already from what you have seen in my practice. The first object, then, that massage effects in these cases is the relief of the pain due to spasm should it be present. The same smooth movement that I am now applying very gently over the swollen parts immediately about the fracture will also bring about absorption of the effused blood with extreme rapidity, so long as the rubbing is smoothly and carefully carried out. The splints used for the treatment of the fracture, you will note, consist of a back-splint with an oblique foot-piece and two straight side-splints, the latter being secured by straps so that they are easily loosened (*vide* fig. 1).

Immediate muscular spasm having been allayed in the manner indicated the side-splints at the end of two or three days are loosened and the limb is left exposed on the back-splint as this man's is (*vide* fig. 2), and every day the massage is employed, at first mainly to get rid of the effused blood round about the fracture. At the end of the third day, again, after practising this smooth massage for ten minutes, passive movement of the muscles and tendons at the back of the ankle and in the calf

should commence. In order to effect this you begin very gently by moving the toes only. The foot is still bandaged and the splint remains in the way you see here. The hand is insinuated under the toes in the way I am doing (*vide* fig. 3) and dorsal flexion of the toes *en bloc* is made (*vide* fig. 4). Every time the toes are bent in that way the flexor tendons are pulled upon, and so a little movement is produced. The movement thus produced in the calf accomplishes the beginning of what is called 'internal massage,' by which I mean that there is a little rubbing movement up and down of the deep muscles in the calf of the leg. This proceeding not only stimulates the circulation, but it makes sufficient movement to prevent immediate adhesions from forming about the fracture, which would otherwise occur. The first passive movement then concerns the toes: this is begun on the third day and continued for two days—say until the fifth day. If all goes well passive movement of the ankle may be commenced from the fifth to the seventh day. For this purpose the limb is allowed to lie quite comfortably, as it will do now, on the back-splint, the side-splints having been removed and the bandage around the ankle taken off, the bandage above the knee remaining undisturbed (*vide* fig. 5). The foot is now firmly grasped with one hand and freely moved at the ankle-joint, the fracture being at the

same time steadied by the opposite hand. After a few days the patient may be allowed to make voluntary movements of the ankle as it lies on the splint, the fracture being steadied by the surgeon's hand. Having arrived at this stage of the process all fear of adhesion about the ankle-joint or the parts behind the fracture ceases. It may happen in exceptional cases that the patient is so over-sensitive or the damage to the soft parts so extensive that the plan cannot be carried out with safety, but if employed with intelligence you will rarely find any case in which it cannot be profitably used. For the passive movements from three to five minutes at each sitting are sufficient. The movements are always preceded by a quarter of an hour's smooth rubbing, by which the patient is generally made most comfortable. These manipulations are repeated day by day, extending at the end of the first fortnight to as much as half an hour for each sitting. At the end of a fortnight—a little more or less, according to the state of union—attention should be given to the joint above the fractured point. The joint below the fracture is, however, naturally the most important, because it is that which is most interfered with if adhesions form. At the end, then, of a fortnight or less, after having done what is necessary for the leg, the knee may be profitably subjected to passive movement. In bending the knee great care must be exercised, because the fracture being only a

fortnight old, or a little more, is not in a condition of anything like firm union. The bending of the knee may be carried out in one of two ways. It may be



FIG. 5.—MASSAGE IN RECENT FRACTURE OF THE LEG

**STAGE 4: Increase of Internal Massage.**—After the usual preliminary smooth massage the bandage fixing the ankle is removed, leaving the limb secured above by the bandage at the knee, and at the seat of fracture by the grasp of one hand of the manipulator. The other hand insinuates between the sole and the foot-piece of the splint firmly but gently grasps the foot and makes passive flexion at the ankle as freely as possible five or six times without moving the fractured bones. The date of commencement of this stage may be any time after the fourth day, but may in difficult cases have to be postponed as late as the eighth or even the tenth day. The object is movement of the ankle-joint and muscles at the back of the leg and the calf to prevent adhesions, especially at the posterior aspect of the fracture. At the end of this stage the splints are replaced as in fig. 1.

done (1) by simply taking the leg, as you have often seen me do, with one hand under the limb just above the heel and the other grasping it under the thigh in the way shown in fig. 6, and then lifting the knee

from the splint. By degrees, as the case goes on, the knee may be raised more and more until at the end of three weeks it is bent up to a right angle. During the whole of these manipulations it must be constantly borne in mind that a recently broken limb is being dealt with. Although that is the plan I adopt in managing these fractures myself in private work or when my masseuse is managing them for me, it is safer for hospital purposes at this stage, after the massage for the foot and leg has been finished, (2) to put on a pair of short side-splints, retained in position with straps or webbings, and then to bend the knee and ankle in the way I show you (*vide* fig. 6). This brings the treatment up to about the end of the third week after the receipt of the injury, and by this time in the majority of cases treated on this plan the fracture is nearly sound—not sound enough for walking, but sound enough for the patient to be left without any splint. The patient can lie in bed if so disposed, or if the patient be a private one and prefers to be getting up and sitting on a couch or chair he may do so after having been provided with a case of poroplastic felt or leather to be worn around the calf over the seat of fracture, as a protection. At the end of three weeks you will find that complete ordinary muscle massage may be thoroughly carried out in order to develop the muscles throughout the limb.

Such is the way in which massage and early movements may be used in any ordinary case of fracture of the leg. The nearer the fracture is to a joint the more important it is that this massage should be carried out, for the simple reason that the nearer the fracture is to a joint the more likely is it that there will be subsequent pain and stiffness.

*Please understand that the use of massage and passive movement in these cases in no respect lessens the necessity for the point of primary importance in all fractures—i.e. placing the fragments at the outset in accurate position.*

Pott's fracture is always a difficult fracture, as is well known not only on account of the difficulty which often arises in the 'setting' of it, but because of the matting of parts which is liable to take place afterwards. Once the bones are in good position in this fracture you need have no hesitation in beginning passive movement in two or three days after the injury at the latest, and smooth massage may be commenced directly after the accident with great advantage. Because Pott's fracture happens to so nearly involve the ankle-joint there is no reason why passive movement should not be used immediately; on the contrary, this is a strong reason for its adoption, for it is only by its use that the avoidance of adhesion and stiffness can be with certainty accomplished (*vide* fig. 7). I have described the case of a

fracture of the leg because it is one of the most easy of fractures to manage. When fractures are treated on the lines I have described it will be found, if the practitioner will devote the necessary time, and when the sufferer has the patience, that a better result will follow than can be effected by any other plan, and that ultimately the time which is occupied in the complete recovery of the patient is little more than half of that which follows the treatment by splints in the ordinary manner.

There is one injury in which the effect of the use of this plan from the beginning is most remarkable—viz. intracapsular fracture of the neck of the thigh-bone. So far as massage of the part is concerned in a fracture of that kind it cannot be commenced too early. If it is started a few minutes after the injury it is not too soon. In such cases, as you well know, the pain is sometimes very acute, and the spasm is often almost continuous, the patient complaining bitterly of the jumping of the limb and the intense discomfort caused by the spasm. The suffering resulting from the spasm can be removed very rapidly by smooth rubbing of the sort I have described. In such a fracture it is unnecessary to trouble about adjustment of the fragments. Bony union you know will not occur, and, failing that, the indication is to obtain as useful a limb as may be. The object in view should be to get a movable and painless limb with the muscles as

strong as possible. No splints should be used. Splints in such cases tend to the production of bed-sores and promote the wasting of muscles. They do

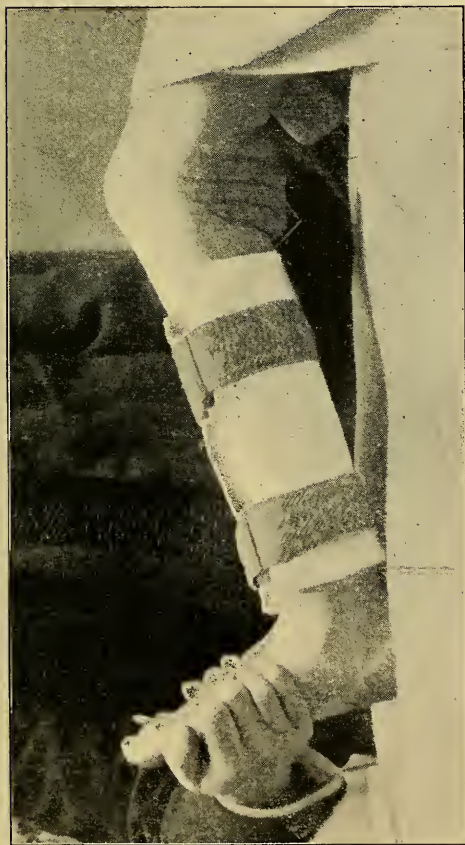


FIG. 6.—MASSAGE IN RECENT FRACTURE OF THE LEG

STAGE 5: *Increase of Passive Movement and commencement of Complete Massage.*—The back-splint is now dispensed with, the fracture being fixed by means of side-splints straight or with foot-piece (Cline's). These having been removed, the limb is laid on the bed or couch, and complete ordinary massage is applied for fifteen minutes. Unless the union is very firm, the fracture is then fixed by two short splints, or, better, by a moulded poro-plastic or leather splint. Passive movements of the ankle and knee are then made in the manner shown in the figure. The flexion at the knee not only prevents stiffness of that joint, but allows more free internal massage by relaxing the calf muscles. The date of commencement may be any time after the fourteenth day, according to the state of the union.

no good, and they render the patient most uncomfortable. Therefore let these cases be treated by smooth rubbing at once and passive movement in 24 hours. A masseuse, or any person with a moderately

soft touch, can give more comfort in a case of this kind than all the drugs and anæsthetics in the pharmacopœia. In a day or two let passive movement be commenced. Have no anxiety about the union, your main objects being to give comfort and prevent muscle-waste : upon the prevention of muscle-waste the ultimate utility of the limb will for the most part depend. The worst thing that can happen in cases of this kind is wasting of the muscles, which can be obviated by intelligent massage. This, then, is the treatment under ordinary circumstances which I strongly commend to your notice in such cases. The use of a splint should be altogether avoided, smooth massage should be commenced at once, passive movement should follow quickly, flexion and extension should be effected by lifting the knee from the bed in the way I show you (fig. 6), and rotation movements should be the last to be practised. For the first three or four days let passive flexion and extension be made as often as possible ; no pain occurs if the limb has been previously rubbed smoothly and gently. In a week or two rotation may be used. Under no circumstances should any passive movement whatever be employed until the neighbourhood of the injury has been subjected to a good smooth rubbing. You may use liniments or not, as you please, but it is the rubbing which does the good.

There are few fractures in the whole body which

are followed so frequently, I suppose, by a certain amount of defective movement as Colles's fracture, the result almost entirely of the matting of the parts. Sometimes it is said that the defects which follow in Colles's fracture are entirely due to the alteration in the relations of the bones produced by the injury. In certain of the cases the bones remain without doubt altered in their relations to one another, but the cause of the want of movement does not, as a rule, lie with the altered bone relations. The cause of the want of proper movement is nearly always adhesions and nothing more, and if these cases are treated intelligently by massage and movements from the first there need be no fear of defective results. The method I use in such cases is as follows:—The fracture having been 'set,' the forearm is placed upon one of the many kinds of splints which have been devised for this fracture—Carr's splints being, I think, on the whole the best; but the kind of splint is immaterial so long as the anterior splint is placed well behind the bases of the fingers. Before the back-splint is applied gentle smooth rubbing should be used, the patient being immediately told to flex and extend the fingers as much as possible and as often as possible. The back-splint should from the first be removed daily for smooth rubbing. In two or three days a little gentle backward passive movement at the wrist should be made whilst the part lies exposed on the

anterior splint after the smooth rubbing. In from four to six days after the injury the part should be gently lifted off the splint after the usual smooth rubbing and held by the manipulator with one hand firmly grasping the fracture area whilst the other hand flexes and extends the wrist a few times in succession. This is repeated daily, the amount of movement increasing gradually as time goes on. In a fortnight the patient may be allowed to make the movements freely of his own accord after he has been provided with a poro-plastic or leather splint for the wrist which is easily removed and replaced. Ordinary complete massage is at the same time commenced daily. At the end of three weeks all splints may be discarded, the arm being carried in a sling for another week only.

Again, let me impress upon you the fact that the most important practical point to be borne in mind in connection with the use of passive movement in cases of recent fracture and other injuries is this: *passive movement should always be preceded by smooth massage, which soothes the irritable muscles so completely that movements of the most complete kind are readily employed without exciting muscular contraction of a harmful sort.* If, on the other hand, passive movement is abruptly attempted without preparing the muscles by previous smooth rubbing violent muscular action generally occurs, which is not only painful to

the patient, but tends to throw the fractured bones out of place. There is, I am sure, no dictum in surgery which is more sound than is this:—In

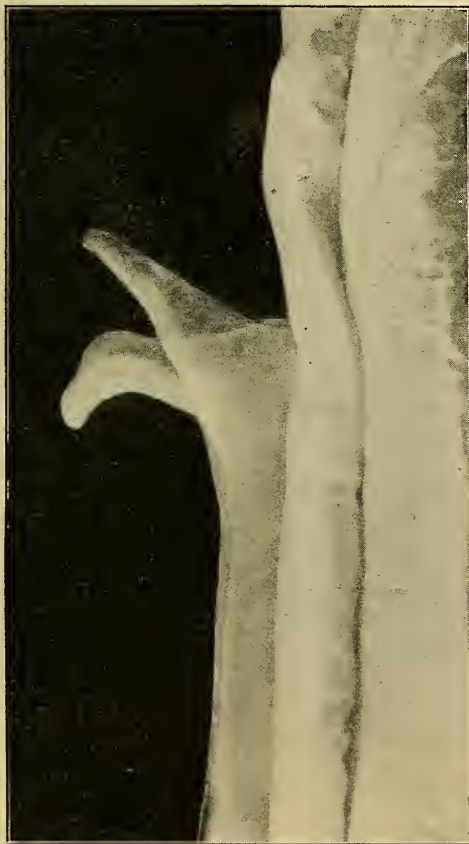


FIG. 7.—MASSAGE IN RECENT FRACTURE OF THE LEG

Showing the amount of voluntary movement at the ankle in a severe case of Pott's fracture two weeks and three days after the injury. When the patient was admitted, immediately after the accident, the foot was displaced completely outward, the transverse horizontal plane of the sole being vertical. The use of all splints was discontinued in the third week.

all cases in which passive movement is practised smooth muscle massage should precede the movement.

Another set of fractures which may be treated by this method with a result which, speaking generally,

surpasses that of any other plan are those occurring in the immediate neighbourhood of the shoulder-joint. The difficulties under ordinary circumstances of dealing with such fractures are too well known to require comment. I am now referring to fractures of the extreme upper end of the humerus and of the scapula close to, or involving, the shoulder-joint. It is a matter, I suppose, of common knowledge that such fractures are followed much more frequently than some people suppose by stiffness of the shoulder-joint. It is, in fact, not uncommon to find upon examining a patient at a long interval after a fracture of this sort that the shoulder-joint is quite fixed, although the patient may be ignorant of the fact. Many patients who have sustained an injury of the kind I am now discussing complain continually of acute pain in attempting to raise the arm to a right angle from the body. In the case of the majority of patients who complain in this way an examination will show that the scapula in the movement mentioned moves with the humerus, and that movement in the shoulder-joint is practically *nil*. In fact, a considerable proportion of people who have sustained this kind of injury, especially if the lesion has been treated by means of continuous splinting or fixed apparatus, never regain free movement in the joint.

The method which I use, because it has given me

the best results in all these fractures about the shoulder in the immediate vicinity of the joint, whether the lesion is of the humerus or of the scapula, commences with smooth rubbing in the ordinary way *at once*. From the beginning of the case I use passive movement very gently indeed. One hand is placed on the shoulder, gripping the part as a whole. This fixes the shoulder girdle. To-and-fro movements of the arm are then gently made, especial care being taken to avoid rotation. If rotation is made movements between the fragments are liable to follow freely, and so union may be delayed or prevented. You need have no fear of harm coming from antero-posterior movement. At the end of three or four days gentle abduction from the side of the trunk is commenced; at the end of a fortnight circumduction may be gently carried out. Rotation should not be attempted for at least a fortnight, after which rotatory movement should be daily made. For these fractures near the joint I do not use splints, excepting a protective shoulder-cap of leather or poro-plastic felt retained in position by straps so that it can readily be removed for the daily massage; nor do I use pads in the axilla. The arm is merely allowed to rest in a sling. By this method the treatment of cases of fracture close to the shoulder-joint may be completed in a fortnight or at the most three weeks, and I have never seen such good results attained in

so short a time by any other plan. If in such cases the parts are confined in splints for long periods a stiff shoulder-joint follows, as I have already said, much more commonly than is generally supposed—a statement which can easily be verified by the examination of cases so treated at long periods (say nine months or one year) after the injuries.

It would obviously be impossible within the limits of lectures like these to give the details of the treatment of every kind of fracture, but the examples I have described give a fair idea of the principles of the plan, which can readily be applied by any intelligent person. It is a method of treatment which must be conducted with discretion. In compound fracture it is not always practicable in the early stages, but after the wound has healed it can be used as if the case were one of simple fracture, and in the earliest stages of many compound fractures there is no reason why passive movement of the joint most likely to be concerned should not be practised at once, although the fact that the manipulations cannot at first be preceded by smooth massage places the practitioner at some disadvantage in such cases. In young children, again, there may be difficulties in using the method in its entirety, but even in these cases it is quite curious how a frightened child with a fractured limb can be soothed by gentle massage of the part.

The great advantages of the treatment are: (1) the ease with which the patient is made comfortable by arresting the muscular spasm, and so relieving the pain; (2) the effecting of rapid absorption of effused blood &c.; (3) the prevention of stiffness by obviating the formation of adhesions; (4) the prevention of muscle-wasting and the preservation throughout the case of the normal nutrition of the limb; and (5) the shortening of the time by about half during which the patient is prevented from resuming the ordinary use of the limb.

The only real objections to the plan are, I think: (1) the difficulty which must often arise in carrying it out, as unless a competent masseur or masseuse is available the time required must frequently be more than the ordinary practitioner can spare; and (2) the fact that the treatment is one requiring so much intelligence and discretion in the mode of its application that it may be difficult at all times to find a person to whom it may be entrusted with safety when the practitioner is not prepared to manage the details himself. The objection which has been raised on the ground that harmful movements of the fractured bones must result is of no value if the treatment is properly carried out, as the movement is then practically *nil*, and certainly not enough to prevent union in any degree whatever. What the results of the treatment of recent fractures by

massage in the hands of others has been I do not know, but so far as my experience is concerned the results are far superior to those obtainable in any other way. I am not acquainted, for example, with any other treatment by which the results depicted in figs. 7 and 8 could be obtained in an extremely severe case of Pott's fracture, and in a case of fracture into the knee-joint.<sup>1</sup> With increasing experience of the method my belief in it has steadily become more sure.

<sup>1</sup> See also Appendix, p. 91.

LECTURE II<sup>1</sup>THE USE OF MASSAGE AND EARLY MOVEMENTS IN RECENT  
FRACTURES AND OTHER COMMON INJURIES (*continued*)

IN my previous lecture the expiration of the time at my disposal compelled me to omit any mention of two varieties of fractures of considerable importance from the point of view of the treatment by the use of immediate massage—viz. fracture of the patella and of the olecranon. Until recently, as you know, the classical method of treating these fractures was by long confinement in splints or fixed apparatus (the period in the case of fracture of the patella extending sometimes to as much as a year or even more), with the object of obtaining as firm a union between the fragments as possible. Under such circumstances it cannot be considered remarkable that in many cases the difficulty in obtaining free movement at the knee at the end of the splinting period was extreme, and that in some cases, indeed, the pain and distress entailed in the necessary treatment were more than

<sup>1</sup> Delivered at St. George's Hospital on February 27, and published in the *Lancet* June 9, 1900.

the patients could endure. So great, indeed, was the pain sometimes under these circumstances that a certain number of people who had sustained a fracture of the knee-cap, rather than bear the pain entailed in getting free movement, preferred to remain with the limb more or less stiff. Speaking generally, the stiffness that follows upon a fracture of the patella, treated upon the old lines, depends largely on the fixation of the upper fragment to the anterior aspect of the femur at the time when attempts at movement are commenced—not, of course, by bony ankylosis, but by adhesions which, forming around the margin of the knee-cap, so tighten the soft parts about it that it is for practical purposes sealed to the surface of the femur. In attempting to get movement in these cases when treated, as I have said, in the olden way, no really good result could be obtained until these adhesions, as well as those in the joint, were loosened—a difficult and painful process which was rendered necessary merely because the parts had been confined so long in splints without movement. Moreover, the strain put upon the parts under these circumstances frequently led to a great stretching and sometimes laceration of the uniting medium. The upper fragment of the patella remained, in fact, at first fixed, and before the exercises had resulted in the breaking down of the adhesions movement was often obtained

at the expense of the stretching of the union, the stretching in some cases being very great; but even in such cases, so long as the upper fragment ultimately became freely movable on the femur, a fairly good limb resulted in the majority. In the absence of the

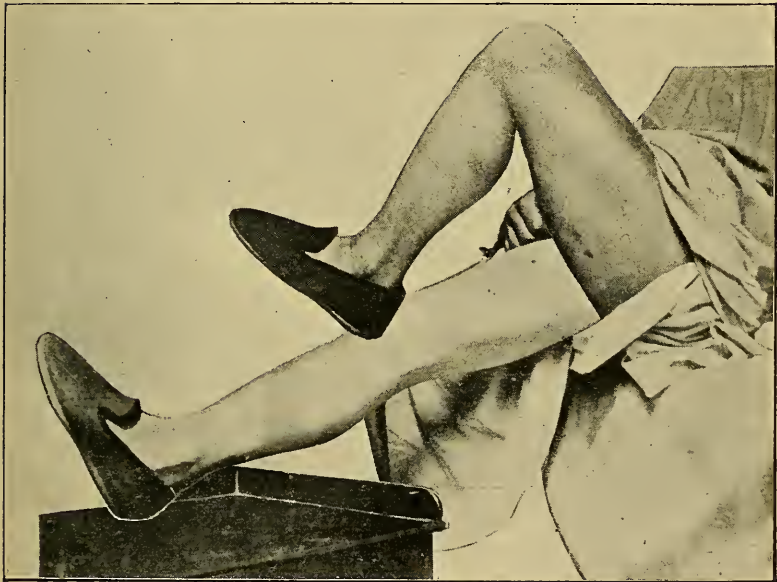


FIG. 8.—MASSAGE AND EARLY MOVEMENT IN RECENT FRACTURES

Showing the amount of movement and the general condition of the left lower limb in a case of fracture through the condyles into the knee-joint six weeks after the injury. The limb is shown in complete extension and in flexion, the effect being produced in the photograph by taking the limb in the two positions upon the same plate (see also fig. 7). At the date upon which the photograph was taken the patient was up and walking about the ward freely with a hardly perceptible limp. The absence of wasting of the limb generally is noteworthy.

treatment by suture now so commonly employed the final result is dependent mainly upon two points: (1) the amount of laceration of the lateral expansions about the knee at the time of the injury (the less the

lateral expansions are ruptured the more strength is there left in the joint after the fracture);<sup>1</sup> and (2) the amount of mobility finally retained by the upper fragment of the patella. If the fragment does not contract inveterate adhesions, and finally becomes freely movable upon the femur, a more or less useful limb follows, the strength of the limb, *as a rule*, then being in inverse ratio to the length of the uniting medium. If, on the other hand, fixation of this upper fragment occurs, then the interference with the mobility and strength of the joint is so great that the patient is much crippled.

The first object, then, in a case of a fracture of the patella, whether wiring has been practised or not, is to prevent by constant manipulation any chance of adhesions forming around the upper fragment and fixing it to the femur—a treatment which excludes any form of splint which makes the patella inaccessible. This necessity for securing free mobility of the patella is not confined to cases of fracture, but if a rapid and perfect result is to be obtained it should be used in all cases of inflammation of the knee-joint, traumatic or otherwise, liable to be followed by stiffness. This is a point to which reference will again be made.

As I have already said, this method of treatment makes the use of fixed immovable apparatus impossible, such, for example, as plaster-of-Paris,

<sup>1</sup> See *Present Position of the Treatment of Simple Fractures*.

silicate of potash, and the like. I may at once state that I have no doubt that the sooner these stiff, immovable appliances become obsolete the better it will be in all cases of damage of joints and in the neighbourhood of joints. The stiffness and pain which so often followed in fracture of the patella when treated upon the old lines were much more frequently due to the treatment than to the injury. The best results which follow fracture of the patella when not subjected to the wiring treatment will be obtained by immediate smooth massage and patellar manipulation, followed in a fortnight or earlier by gentle passive movement of the knee, during which *the upper fragment should be firmly fixed by the hand of the manipulator in order to prevent its being drawn up towards the thigh.* By this means if effectually managed flexion to a right angle can generally be accomplished without increasing the separation. In this way, in the majority of instances, a useful limb may be expected in three months, all splints being discarded at the end of the first month. It is remarkable how little, if any, stretching of the union occurs in cases treated in this manner *when care is taken from the outset to secure free movement of the patella upon the femur.*

The same observations apply with equal weight in the case of fracture of the olecranon. It will be found upon examination that in the majority of cases

of fracture of the olecranon treated by long-continued immobility in splints the detached fragment of the olecranon is fixed to the humerus. I do not mean that it is always fixed by bony ankylosis, but it is connected to the humerus by such strong adhesions that it is very difficult to move it at all. Further, it will be found that the utility of the limb in such cases is in direct proportion to the mobility of the detached fragment upon the humerus—in fact, the utility of the limb depends more upon this factor than upon the apparent strength of the union. When the fragment is fixed it will be found upon commencing to bend the joint that movement is obtained, not by the gliding downwards of the upper fragment upon the humerus, as should be the case, but by a stretching of the union, the fragment remaining fixed; and in such cases, although flexion may be obtained to a great degree, and sometimes completely, extension power is almost, if not entirely, wanting. So much is this sometimes the case in exaggerated cases that although the patient may be able to semiflex the arm or, perhaps, to flex it completely, if the limb is raised above the shoulder or by the side of the head the forearm falls down almost as in a paralysed limb in consequence of the triceps having lost its power from the fixation of the detached olecranon to the lower end of the humerus. If in the treatment of such a case trouble be taken

during its early progress to constantly move the detached portion of the olecranon upon the humerus by a little gentle flexion and by lateral manipulation,

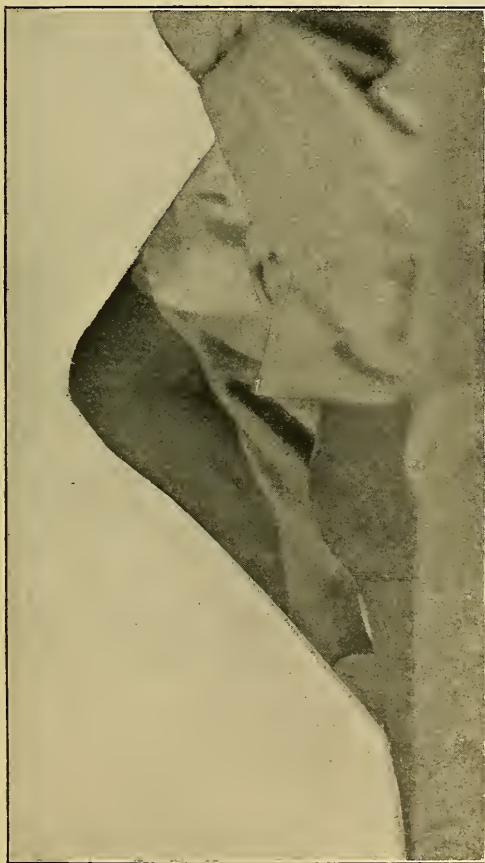


FIG. 9.—MASSAGE AND EARLY MOVEMENT IN RECENT FRACTURES  
Showing the amount of movement allowed in a case of fracture of the patella six weeks after the accident. The limb is shown in the two extreme positions, i.e. complete extension and semi-flexion; the effect is produced in the photograph by taking the limb in the two positions on the same plate, as was done in figs. 7 and 8.

*care being taken that in flexion the detached fragment is made to follow the movements of the forearm, which is easily done by making pressure in a downward direction during passive movement, all adhesion is*

prevented and the patient probably recovers with a limb which is practically almost as useful as if there had been no fracture at all—the utility of the limb here, as in fracture of the patella, when the union is fibrous, depending upon the freedom of movement of the detached fragment as much as or, indeed, more than upon the actual strength of the uniting medium.

The two cardinal facts to bear in mind in the rational treatment of fracture of the patella and fracture of the olecranon are these: 1. The avoidance under all circumstances of any chance of the upper part of the patella or of the olecranon becoming adherent to the subjacent bone. Such adhesion may be prevented by massage and lateral manipulation combined with gentle flexion and extension, during which the detached fragment is made to move as much as possible with the distal portion of the limb—i.e. with the leg or forearm as the case may be—the lateral movement being the most readily managed and resulting in the least disturbance of the parts generally. 2. All manipulation and passive movement should be preceded by smooth rubbing of the muscles. By this treatment you will in the majority of cases provide the patient with a limb which is useful to an extraordinary degree beyond that which follows when this plan is not used. I am, of course, speaking generally only,

because occasionally a case treated by other methods without operation will leave a sound and good limb, but many of the cases so treated are very imperfect both in movement and in power.

When the fracture of an olecranon is treated by wiring, screws, or pegs the same cardinal points must be borne in mind. Massage and passive movement cannot be practised too soon, nor can the patient be encouraged too soon to use gentle voluntary movement at the elbow-joint.

I may perhaps be allowed a moment's digression here to explain, in order to avoid any misunderstanding, that the remarks which I have just made must not be held to imply that I have any wish to substitute in a general way treatment by massage and manipulation for the operative measures now so commonly employed in fractures of the olecranon and patella. I am second to none in my estimation of the value of these measures; but there must always remain a number of cases which, for reasons which it would be foreign to my present purpose to discuss, are not suitable for operation—some in themselves, some because the patient does not desire operation, and some in consequence of the circumstances in which the practitioner finds himself being not such as to justify his undertaking operative measures. In such cases intelligent massage and manipulation will produce a better result than any

other plan, and in many instances will restore the limb to a degree of usefulness which cannot even be excelled by operative treatment.

### IMMEDIATE MESSAGE AND MANIPULATION IN DISLOCATIONS

For the better understanding of the remarks which follow it is necessary to insist upon the following elementary points. If a dislocation be complete in the ordinary acceptance of the term the capsule of the joint must, as a matter of course, be torn, the rent in the capsule being of large or of small extent. The obstacles to the reduction of a dislocation depend comparatively little, as a rule, upon the situation or character of the laceration in the capsule; occasionally only do some of the difficulties met with in attempts at reduction lie with this structure. The real difficulty is for the most part due to muscular contraction—a fact which is amply proved by the manner in which most difficult dislocations will often reduce themselves as soon as the patient is fully anæsthetised. The longer a dislocation remains unreduced the more marked does this contraction of the muscles become, and the more difficult is it to remove the bone from its abnormal site. Supposing that a dislocation remains unreduced for five, or six, or eight weeks

in a case such as that of the shoulder, physiological shortening of the muscles takes place; and in consequence a reduction of the dislocation by ordinary means may become practically impossible. I mention these facts, not because I suppose you are unfamiliar with them, but because I wish to emphasise as strongly as possible the importance of muscular contraction and shortening as obstacles to reduction in the vast majority of the dislocations with which we are ordinarily called upon to deal. For practical purposes the capsule and surrounding bony points may be ignored, since if they form any obstacle to reduction it is generally secondary to the condition of the muscles.

It is further a most important point to bear in mind that under ordinary circumstances after the reduction of a dislocation the retention of the replaced bone in its normal site depends not so much upon the state of the capsule, which in reality has little to do with the matter, as upon the muscles, aided in certain cases by atmospheric pressure. In fact, the question of the healing of the rent in the capsule is of small importance compared with that affecting muscle-waste. The capsule will heal equally well whether the joint be kept fixed in splints or whether it be subjected to passive movement from the first. The muscles about the joint, especially those supplied by the same nerves as supply the articulation, waste rapidly if the joint be kept fixed for ever so short

a time, and if the fixation be kept up for long periods this wasting may proceed so far as to be incurable. On the other hand, if massage and passive movement be at once commenced, then wasting can be entirely prevented, in the absence, of course, of actual nervous lesion. If the muscles are allowed to waste to any great extent, as you can easily see for yourselves by watching an ordinary case, the whole joint becomes loose and flabby. There is no such thing as a primary tonic condition of the capsule of the joint : the capsule of the joint is a passive structure, and has no contractile vitality of any sort beyond that which it derives from muscular attachments and expansions. Hence prolonged fixation of a joint after the reduction of a dislocation allows the muscles to waste, which is tantamount to bringing about the precise conditions which tend to recurrent dislocation if attempts to obtain free movement are made at a later period. The effect of even temporary fixation of a joint in the production of adhesions which have subsequently to be treated, often for long periods, I need hardly, I suppose, impress upon you ; although I fancy that if you were to examine a large number of patients who have had dislocations, say of the shoulder-joint, at a long period after the injury, you would be surprised to find that the percentage of cases in which some stiffness still persists from this cause is very considerable.

In the practice of the older school of surgeons prolonged fixation of a joint after dislocation was almost universal, the main object being to allow of a firm and rapid union of the rent in the capsule. So much was thought of the value of the healed capsule in retaining the parts in position that the disadvantages of adhesions and muscle-waste were held to be of no account compared with the vital importance of the completely restored capsule. I strongly recommend you to reverse these conditions by concentrating your attention upon measures for the avoidance of adhesions and muscle-waste. Ignore the torn capsule; the rent will heal soundly in spite of any rational manipulations or movement it may be subjected to in treatment. Ingenious operations which from the nature of things cannot effect material good have been from time to time invented with a view to the cure of recurrent dislocation by shortening the loose capsules, the fact having been overlooked or forgotten that looseness of the capsule is secondary to muscle-waste, which is the real thing to be combatted. The only available method by which muscle-waste can be avoided in these cases of dislocation, especially of the shoulder, is massage, commencing immediately after the reduction of the displacement—smooth rubbing only for the first two days, after which passive movement follows the massage. *This passive movement may be very free in*

*all directions save that which is towards the muscles which tend to waste. For example, in the case of the shoulder, abduction of the arm from the trunk should not be practised for a week or ten days after the injury, because the strong action of the adductors, unopposed for the time being by the weakened deltoid, tends to displace the head of the humerus inwards.* For the same reason in the first week no *voluntary* movement should be allowed, all movements being *passive*. Treated on these lines any dislocation of a major joint—*e.g.* shoulder or hip—may be cured in from two to three weeks without adhesions and with no stiffness remaining.

All cases of recurrent dislocation will be found to be associated with marked muscle-waste. The cardinal principle in their treatment is in the direction of rectifying the atrophy of the muscles by massage and methodical exercises with or without electricity, and not in the direction of shortening the lax capsule by operation.

The beneficial effect of massage in dislocations is not limited to the treatment after reduction; it is sometimes of great use as an aid to reduction. The following case will serve as an illustration of this point. A highly sensitive and nervous lady, considerably beyond middle age, dislocated her shoulder in a fall which followed a slip on some parquet flooring. There was extreme pain, and the muscular

spasm was intense, the least attempt to move the parts eliciting loud cries from the patient. Whilst waiting for the arrival of an anæsthetist, as the muscular spasm was so great, I gently massaged the region of the shoulder, upon which the pain was soon modified and by degrees disappeared. In the course of the rubbing I noticed that the muscles became less hard, and especially I observed that the *hollow tension* of the deltoid was succeeded by a feeling of almost softness. Seizing the favourable moment I passed my right hand into the axilla and with a sudden outward jerk reduced the dislocation easily (the displacement was sub-glenoid); in fact, had an anæsthetic been administered reduction could not have been more easily effected. In two other cases of dislocation of the shoulder of a similar kind, one being sub-coracoid, the other sub-glenoid, I have in the same way effected reduction with remarkable ease. Cases like these show further the point I have already insisted upon—viz. the importance of concentrating your mind upon the condition of the muscles in cases of dislocation.

Before leaving the subject of dislocations allow me again to refer to the question of muscle-waste in these cases, because I do not think in some instances it is sufficiently understood. In the case of the fleshy joints—*e.g.* the shoulder and hip—muscle-waste, unless the massage treatment is adopted, is too

obvious to require comment. Wasting in the same manner occurs uniformly in all dislocations, although I hardly think that this is recognised by some people. The wasting, for instance, of the quadriceps in certain conditions of the knee is of common knowledge, but I venture to think that the wasting of the muscles controlling the ilio-tibial band is but little realised. Again, it would at first sight seem almost impossible that any wasting of muscles should follow upon dislocations of distal joints like those of the phalanges of the fingers which are quite remote from muscular bellies ; yet in these it will be found, if examination be made, that there is universally some wasting of the forearm, and, further, that the permanent sense of weakening which is complained of by some of the patients who have suffered from these injuries can only be rectified by voluntary exercises or by thorough massage of the forearm muscles. The bearing of these points upon the scientific treatment of these injuries is too obvious to require explanation ; it is, I am sure, of much more importance than is commonly thought. It would, of course, be interesting to describe *seriatim* and in detail the management of the various dislocations throughout the body by immediate massage and passive movement, but time will hardly allow of this. I hope, however, that what I have been able to say will be sufficient to indicate the general principles upon which the treatment should be conducted. Its

modification to the requirements of the different joints is merely a matter for the exercise of ordinary intelligence.

### IMMEDIATE MASSAGE IN SPRAINS, WRENCHES, AND BRUISES.

As is the case with dislocations, as I have endeavoured to explain, the objects to be attained in the treatment of sprains, wrenches, and bruises are the restoration to the normal state by the rapid removal of effused products, the prevention of adhesions, and the avoidance of muscle-waste. Any treatment which fails to obtain these ends is defective. Further, it is, I am sure, undeniable that the only plan of treatment which will attain the desired end with certainty and in a reasonable time is that of immediate massage and very early passive movement—a plan which is, if intelligently used, applicable universally, with the exception, perhaps, of a few special cases.

First, with regard to sprains. For our present purpose by a sprain is meant an injury to a joint, a muscle, or other soft part by a wrench, a bend, or a twist. There is always some laceration of the tissues, but there may be no open wound. In the case of a joint the injury always involves some tearing of the fibres of the capsule, synovial apparatus, or cartilage.

There is pain of variable degrees, and there may or may not be effusion into the joint. Generally, if the sprain is of any severity there is effusion into the joint; if the effusion follows immediately upon the injury it is blood; if it follows a day or two subsequently it is due to synovitis. I must again crave indulgence for emphasising such elementary points. The occurrence of this laceration in cases of sprain—which means, of course, a subcutaneous wound—led to the faulty practice of former times, which is even now, I fear, far too prevalent, of placing parts so injured for a long period in splints: the best possible method for facilitating the formation of adhesions and the perpetuation of muscle-waste, the main object of this mistaken treatment being to allow of the rapid healing of the wounded tissues—a point of comparatively small importance.

In order to make clear the plan of treatment which I use, and which I strongly advise you to adopt in these injuries, let us take the case of a man who has sprained his knee. At the time of his coming under observation—say a few hours after the injury—the joint is painful, swollen from effusion (probably for the most part blood), and any attempt at movement of the joint is resisted. The first indication is the removal of the effusion. With this object the patient is, if possible, sent to bed and the limb is placed upon a light back-splint—a ham-splint

being the most convenient—applied so that free access is left to the joint. Gentle smooth massage over the swollen joint is commenced at once. In very severe cases this is sometimes resented at first by the patient, whose resentment, however, soon subsides when he realises the soothing effect which the gentle rubbing produces. In the intervals of the rubbing fomentations of lead and opium may be laid upon the joint; the opium soothes somewhat and the lead hardens the skin a little, which is useful in the subsequent management. From the first gentle passive movement of the patella is used, for the reasons which I have already sufficiently indicated. As soon as the effusion has distinctly commenced to subside, as is shown by the decrease in the tension of the joint, gentle passive movement (flexion and extension) is commenced, and if upon the commencement of the passive movement no increase of effusion occurs the splint is put aside altogether. When the patient comes under treatment immediately after the injury the splint can generally be dispensed with on the third day. With the discarding of the splint gentle massage of the thigh and leg is added to the rubbing of the joint itself, the passive movement and the massage becoming more and more thorough as the effusion subsides. A compress of the kind mentioned may be used in the intervals if it is comfortable to the patient. Treated in this simple way there

are few cases of severe sprain of the knee in which the patient may not be getting about comfortably in a fortnight, at the end of which time another fortnight of methodical exercises, either in a gymnasium or by means of a 'home' exerciser, will generally complete the cure. I have taken as an example a severe case requiring confinement to bed. The treatment of the milder forms is modified to the necessities of the case, the great points to be borne in mind being the necessity for avoidance of the use of splints after the effusion has commenced to subside, the immediate use of massage to the joint, and early passive movement. In all cases the early movement should be passive—the habit of sending the milder forms of sprains at once to the gymnasium is to be avoided. In no case of sprain should a cure be considered to have been obtained if any sign of wasting of muscle beyond that which comes from mere disuse remains. The longer the time which intervenes between the receipt of the injury and the commencement of the rational treatment the greater is the difficulty in rectifying the muscle-waste with its necessarily concurrent weakness, and in cases in which the parts have been long confined in splints a cure in the true sense is sometimes impossible.

The following points in the carrying out of passive movement in cases of sprain are of some moment.

The first movements used should be those of the simplest kind; for example, flexion and extension in the hip or knee, antero-posterior movement in the shoulder; abduction and adduction should then follow, and finally rotation and circumduction in joints permitting of that movement. This sequence, however, is always interrupted for the following reason, which is of paramount importance: *the last movement to be practised should be that which, so far as can be ascertained, was concerned in the production of the injury.* Let me make myself clear. Suppose for a moment that a severe sprain of the shoulder has been caused by a fall on the hand or elbow, the arm having been at the time widely abducted from the side; the damage will be probably about the inner aspect of the capsule or under the acromion. In such a case passive abduction should be the last movement practised, as it would be the movement most likely to irritate the part immediately lacerated or bruised. Although it should be the last movement to be commenced it should not, however, be long deferred, seven days being probably the limit of time which can with safety be spared before its commencement. Again, in the sprain occurring in internal derangement of the knee-joint the injury is almost always caused by either internal or external rotation. In such a case, therefore, the last movement to be practised is rotation. Indeed, it is, speaking

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generally, better to avoid rotation altogether in that particular class of case.<sup>1</sup>

In sprains complicated by external wound it is clear that the plan which I have been advocating cannot immediately be adopted in its entirety, nor can massage be comfortably practised directly over the damaged part when the skin is abraded or raw; but in such circumstances massage of neighbouring muscles and passive movement should always be practised, the peculiarities of each case dictating the modifications which are necessary in the application of the treatment.

I had intended giving some details of the treatment of simple bruises by this same plan of massage and movement, but the allotted time has been more than spent. All, therefore, that I can say is that in these cases the method of its application and the objects are the same as those already mentioned—viz. the rapid removal of effusion and the prevention of matting of the injured parts.

In conclusion, allow me to say that I have no desire that the treatment which I have been now advocating should be used to the exclusion of all others. My main object is to urge upon you the desirability of shaking off to some extent the incubus of the traditional routine treatment of fractures and the other kinds of injury of which I have been

<sup>1</sup> See Lecture III.

speaking by prolonged splinting, strapping, counter-irritants, and so forth, and, unless unavoidable circumstances prevent, to substitute a line of treatment which is, I am sure, rational, and will in the end be found, by anyone who will take the trouble to acquire a personal experience of it, to produce in a general way results far superior to those obtainable by other plans.

LECTURE III<sup>1</sup>INTERNAL DERANGEMENTS OF THE KNEE-JOINT  
(POPULARLY CALLED 'SLIPPED CARTILAGE')

SOME of you probably recollect having seen me operate a few days since upon a patient in the Fitzwilliam Ward who was generally supposed to be suffering from the results of a displaced semilunar cartilage in the right knee. The operation, however, showed that the symptoms were not due to that cause, but arose from an abnormal fold of synovial membrane connected with the ligamentum mucosum which from time to time became nipped between the bones. The occurrence of this case gives me the opportunity, for which I have been for some time waiting, to call your attention to the condition of the knee-joint—for clinical purposes indifferently styled 'internal derangement,' 'displaced semilunar cartilage,' or 'subluxation'—which is not only interesting in itself, since its comparatively common occurrence brings it under frequent

<sup>1</sup> A clinical lecture delivered at St. George's Hospital and reprinted from the *Lancet*, January 4, 1900.

observation in practice, but is also well worthy of that careful consideration which is especially desirable in conditions in which, from long familiarity, the respect which naturally attaches to tradition leads to the adoption at times of accepted views without much critical inquiry. Some of the conclusions in respect to diagnosis and treatment to which I shall refer in the following lecture will, I fear, be found to differ from the views commonly held; they are, however, the outcome of the careful study of 200 consecutive cases.

#### ANALYSIS OF THE CASES

The total number of cases in the series numbered 200 (182 males and 18 females): these included only such as presented the characteristic symptoms under discussion, all cases which could be classified under the head of 'loose bodies' commonly so called being excluded. The ages of the patients varied from 13 to 62 years. The left knee was affected in 133 cases and the right in 57. The inner side of the knee was the seat of the symptoms in 155 cases, and the outer side in 45 cases. Ninety-eight cases were seen after the first attack and 47 after the second; in the remainder the number of attacks occurring before the patient came under observation varied from three to 22. With the exception of 20 cases, which were too far advanced, all were at first treated

by temporary rest, massage, and exercises : of these 112 were cured, 83 without the use of any support or other apparatus ; in 39 temporary support was necessary for times varying from three months to one year. In no case in which the rest and massage treatment was commenced after the third attack was sufficient improvement effected to enable the patient in the absence of operation to entirely dispense with the use of support of some kind, but in a certain proportion of these the support was only used as a precaution under special circumstances. The cases in which a support was used permanently (being worn either continuously during the day only or at various intervals) amounted to 58 : of these the treatment commenced after the first attack in 25, after the second attack in 18, and after three or more attacks in 15. Three patients declined treatment altogether. Operation was performed in 27 cases (all males) :<sup>1</sup> of these the semilunar cartilage was at fault in 15 only ; of the remaining 12 the causes of the trouble were small pedunculated bodies in four instances, and abnormal folds of synovial membrane springing from behind or near the ligamentum patellæ in eight. In the 15 cases submitted to operation in which the semilunar cartilage was involved the left knee was

<sup>1</sup> Whilst correcting these pages for the press I have operated upon a girl twenty-four years old—my first operation in a female for displacement of a semilunar cartilage.

affected in 12; of the other operation cases seven occurred in the left knee and five in the right.

It is hardly needful to say that these cases do not represent my whole experience of this condition. I have, however, thought it well to confine my observations to this series, as the cases coming under my notice previously were not observed with sufficient care to justify any definite conclusions, although the impressions they led me to form were practically the same as the views resulting from the consideration of the series under notice now.

Since the materials for this lecture were got together, about eighteen months ago, 53 additional cases have come under observation, mainly in private practice. Of these only four were in females. In all the symptoms were typical of what is commonly called 'slipped cartilage.' The left knee was concerned in 38 cases, and in 42 cases the symptoms pointed to the inner cartilage being involved. Eight cases were subjected to operation (all males), and of these three only showed anything abnormal with the semilunar cartilage; the remaining cases were examples of hypertrophied synovial folds, all of which, with two exceptions, came from behind the ligamentum patellæ. In one case many hypertrophied masses were taken away.

Taking the total number of cases observed, including the 53 now added, i.e. 253 in all, it will be seen that 35 were operated upon. With the exception of the single instance mentioned further on, in which a very slight limitation of movement followed, the results in all the cases were perfect, and no anxiety of any sort

arose in connection with them except in two the details of which follow.

The large predominance of cases in which the left knee is involved requires a passing notice. So far as I know, no reason has been advanced for this preponderance, although it is commonly admitted. I do not think the explanation offers much difficulty. The symptoms in these cases are almost always caused by a rotatory movement of the femur upon the tibia, or *vice versa*, and it will be seen upon consideration that in the majority of occupations or amusements associated with a swing of the body the swing is, in right-handed persons, from right to left (note, for example, the swing of the body in cricket, whether bowling or batting, in golf, in the work of the ordinary labourer, &c.), the result being that the left knee is, speaking generally, more liable to rotatory strain than the right.

#### THE SYMPTOMS AND THEIR CAUSES

The train of symptoms usually recognised as indicative of the lesion are precise enough—viz. sudden pain with or without a sensation of something having slipped out of place in the joint, complete fixation or limitation of the power of extension of the leg upon the thigh at any angle between complete extension and a point half-way to semi-flexion, followed by effusion into the joint, with tenderness over one or other semilunar cartilage. These symptoms may occur apparently spontaneously during some normal movement, or may result from a violent wrench or blow. Speaking

generally, rotation movement of the leg upon the thigh is a prominent factor in their causation. Relief may follow almost immediately from spontaneous reduction of the displaced or nipped structure, or it may be effected by reduction by manipulation.

In some cases, principally the slighter ones, which for reasons to be stated are of extreme interest, manipulation not only fails to give relief, but may cause an increase of the symptoms. It is not infrequently said that in marked cases of displacement of the semilunar cartilage the structure can be felt upon palpation, but I venture to think that these cases must be very few in number; it is often possible to feel some fulness along the line of the cartilage, but I believe it is, as a rule, merely the swelling from blood extravasation with or without inflammatory exudation, and I am sure that the existence of thickenings of this kind is no certain sign of displacement of the cartilage. In fact, so far as I know, the only positive sign of the lesion being a displaced cartilage is the occurrence of a deficiency, upon comparing opposite limbs, above the head of the tibia on the affected side in consequence of displacement of the cartilage freely inwards. Projecting thickenings are no evidence of cartilage displacement, since any loose body fixed between the bones may give rise to exactly the same abnormality in outline. It is a matter of common knowledge

that, although the train of symptoms in these cases is so precise and clear, the causes to which they are due are by no means always the same, and may be classified as follows: (1) displacement of a semilunar cartilage; (2) the nipping of folds or shreds of synovial membranes between the bone ends; and (3) loose or pedunculated bodies in the joint. To these three commonly recognised causes I venture to add (4) bruising of the peripheral edge of a semilunar cartilage and its attachments without displacement or necessarily loosening, the immediate result of the lesion being a local effusion of blood (subsequently reinforced by a certain amount of inflammatory exudation), a portion of which insinuating itself between the bone ends acts as a foreign body. To this condition I have heard no allusion made, nor have I met with any mention of it in surgical literature. It is, however, I believe, the cause of the train of symptoms in the majority of the milder cases of so-called 'slipped cartilage.' It is quite curable by proper treatment, whilst if neglected or improperly managed at first it leads to some of the most intractable cases of the graver sort.

In order to make my reasons for this belief clear it is necessary to refer to the following elementary points. The essential symptom in all these cases is, as everybody knows, the fixation, or at all events limitation in the movement, of the joint resulting

from the existence of foreign material between the bone ends. If the foreign substance be a portion of a semilunar cartilage, loose body, or fold of synovial membrane, the symptoms are very pronounced; but they disappear at once after reduction has been effected, whether the reduction occurs spontaneously or is brought about by manipulation, the movements of the joint being at once recovered. The only positive evidence of successful reduction lies in the ability to extend the leg upon the thigh without resistance as completely as in the sound limb; anything short of this is held to show that some mechanical obstacle in the way of foreign material between the bones still exists. Unless my experience is exceptional, it must have been noticed by others in many cases of the milder sort, in which the limitation of movement is only slight, that although the symptoms are precise enough the limitation in the extension of the leg cannot be rectified by manipulation, however carefully it may be carried out; 'reduction' of the 'displaced' material cannot, in fact, be accomplished. Not only does the inability on the part of the patient to completely extend the limb remain unchanged by the manipulation, but it will be found that even under an anæsthetic it is impossible to completely straighten the limb. It is true that if the patient whilst anæsthetised be laid on his back the limb can be put practically straight if firm backward

pressure be made upon the front of the knee; but upon the removal of the pressure the knee immediately springs forward, leaving the limb bent to the same degree as before it was straightened in the manner indicated. The failure of attempts at 'reduction' in these cases is due not necessarily to any want of skill in the manipulation, but to the fact that there is nothing present which in the ordinary sense is reducible. In spite of the apparent intractability of these cases at first they invariably recover completely if properly treated, and show no tendency to recur. The important point to notice in their progress is this: the recovery of complete extension is *gradual*, never sudden, as is the case when a foreign body has been withdrawn from between the bones. In these cases the symptoms arise, I believe, from the swelling due to bruising and laceration about the peripheral margin of the semilunars and their attachments without displacement, the gradual recovery of free movement being due to the slow absorption of the effused products. The gradual way in which the normal state is regained is in itself enough to negative the existence of anything like a foreign body, in the ordinary sense of the term, between the bones, and the nature of the treatment by which recovery is brought about, added to the absence of any tendency to recurrence in properly managed cases, is strongly corroborative of this

contention. Additional evidence of a very positive sort is afforded by two of the cases treated by operation in the series now under consideration: these two cases were for practical purposes alike; it is therefore sufficient for my present object to give the details of only one of them.

A soldier, about thirty-two years old, after a wrench of the left knee, suffered from the usual train of symptoms associated with 'slipped cartilage'—i.e. sudden pain, tenderness over the internal semilunar cartilage, and inability to straighten the limb completely at the knee. Attempts were made by an onlooker to 'put the knee in,' but without success. The patient, however, continued to get about with a partially stiff limb, and shortly afterwards, no proper treatment having been adopted, he was ordered on active service. With the knee in the condition indicated he with difficulty got through a campaign of some months' duration. From time to time after some strain or injury an acute sudden attack of pain, followed by effusion into the joint, occurred. I saw the patient about six months after the original injury; during the whole of this time the leg had never been completely extended upon the thigh. There was some effusion into the knee with increase of local heat; the knee was slightly flexed, and could not be extended either by the patient or by passive movement. Over the middle of the in-

ternal semilunar cartilage was a spot of acute tenderness ; a little fulness was also distinctly felt. From this tender spot the acute pain which followed upon any strain or other injury always started. After the treatment, which I shall presently describe, the knee had nearly regained by degrees its natural state, extension being almost complete, when unfortunately another strain reproduced the old condition. Subsequent attacks of the same kind followed, and it was evident that unless the abnormal state could be cured by operation service in the army must be abandoned. I therefore operated with the usual precautions. The parts about the base of the semilunar cartilage inside the capsule of the joint over the tender area were swollen and infiltrated with blood (some of long standing) and exudation products. The cartilage itself was not detached, and clearly could never have been displaced. Before removing the affected parts an attempt was made to straighten the limb, the capsule of course being freely open, without success. After the removal of the swollen tissues, including the portion of cartilage involved, the limb immediately fell into a perfectly straight position. A portion of the swollen mass which could be seen lying between the bones at the posterior part consisted of partly organised old blood-clot. The cartilage itself was hardly recognisable at first in the centre of the mass removed, as it had entirely lost

its ordinary aspect, and resembled more than anything else, both in appearance and to the touch, a piece of sodden felt; in front and behind this the cartilage differed but little from its usual anatomical characteristics. Creeping over the articular cartilage of the internal condyle for a distance of at least half an inch was a delicate layer of pink granulation tissue, beneath which the cartilage was eaten away. From the general aspect of the case it was manifest that the condition, if left to itself, must have developed sooner or later into pulpy disease of the knee-joint. The altered cartilage having been removed and the bones cleared of old blood-clot and exudation tissue the wound was closed in the usual way. The progress of the case was naturally tedious, and altogether caused me more anxiety than any other case of the same kind with which I have up to the present time had to deal. The final result was good, and the patient rejoined his regiment in about four months.

In the other case, less advanced than the one just detailed, the condition of the parts and the appearance of the cartilage were precisely the same.

In two other cases in which a displaced semilunar cartilage had been long neglected, the structure presented the same sodden felt-like appearance. This felt-like condition seen in some of these cases is of considerable interest, as it shows without doubt,

I suppose, that the cartilage must either have been completely crushed at the time of injury, had become changed in consequence of subsequent inflammatory processes, or had become altered in consequence of constant grinding pressure to which it had been subjected. Of this peculiar change in the semilunar cartilage I find no mention in the authorities I have been able to consult, but I am informed by an eminent surgeon that he has met with cases of the kind. The recognition of this bruising and laceration about the semilunar cartilage without displacement as a cause of the symptoms commonly associated with 'slipped cartilage' is of considerable moment in the treatment of such cases, as will presently be seen.

In one of the additional cases operated upon this sodden felt-like condition of the affected cartilage was found.

### TREATMENT

This may be conveniently considered under three heads: (1) the treatment by temporary rest, massage, and exercise; (2) the treatment by the use of apparatus; and (3) the operative treatment.

1. *The treatment by temporary rest, massage, and exercise.*—The views of surgeons with regard to the best method of treating these cases naturally differ. In the present lecture I propose merely to give the

details of the measures which in my hands have proved the most successful. The first indication obviously in every case is the replacement of the structure apparently dislocated, if reduction has not already been effected either spontaneously or by manipulation prior to the patient coming under observation. The desirability of using an anæsthetic in attempts at reduction must depend partly upon the nature of the case and partly upon the disposition of the individual concerned. The actual mode of procedure in attempting reduction it is superfluous to describe here. In exaggerated cases—i.e. those in which there is complete fixation or great limitation of extension movement—reduction must be effected by repeated efforts if a single attempt fails; in some of the slight cases (those which I venture to classify as bruised or lacerated cartilage and attachments) it will be found that the power of complete extension cannot be suddenly restored by any manipulations. In such cases, a thorough attempt at reduction, if need be under an anæsthetic, having been made without restoring the complete extension movement at the knee-joint, no repetition of the attempt should be made, since there is nothing to replace. The failure to appreciate this fact, resulting in repeated futile attempts at replacing the structure which is supposed to be displaced, has been the cause of some of the worst cases of traumatic arthritis of the knee-

joint with which I have had to deal, and in two instances led without doubt to the development of tuberculous disease. The immediate treatment of all cases, whether they are those in which movement has been restored spontaneously or by manipulation, or whether they be of the kind in which some slight flexion exists in spite of attempts at reduction, is complete temporary rest by fixation of the joint on a light splint, a compress of warm water, or, as I prefer, since it is more soothing, one of hot *lotio plumbi cum opio*, being kept continually applied. The period during which this rest is maintained varies from four days to a week; the time, in fact, which is usually occupied in getting rid of the effusion into the joint. The less the joint is subjected to movement until all effusion has disappeared the better is the chance of a perfect result finally. I am certain, from my own personal experience and from what I see and hear of the results of the practice of others, that nothing militates against a successful end in these cases so much as the use of exercises, passive, or in the gymnasium, immediately after the injury; it is, in fact, in my opinion, quite the worst practice that can be adopted, since the commencement of exercises immediately, as is recommended by some, is, I have no doubt, at least as bad as the opposite extreme, in which a limb may be crippled by being kept at rest too long.

Although no movements of the joint should be commenced until all effusion has gone, massage of muscles and joint *without movement* cannot be commenced too soon; not only does the early massage expedite the disappearance of the fluid more than any other means, but it seems to check, if not to altogether prevent, the rapid muscle waste; and, most important of all, it greatly obviates *the tendency to flaccidity of the capsule of the joint, which is such a fruitful cause of failure in these cases*. Nothing is more striking, I think, than the rapidity with which the muscles of the thigh and, to a less degree, those of the leg waste if left to themselves in this injury. In my cases, therefore, from the first during the temporary rest the limb is subjected to thorough massage without knee movement daily, and if the circumstances admit twice a day. Upon the disappearance of the effusion, which in well-managed cases is rarely later than a week from the time of the injury, exercise by passive movement is commenced, *care being taken that no rotatory motion is imparted to the leg*. The avoidance of rotation is the essential point in these early movements; in the gymnastic treatment this cannot be with certainty achieved. The rotation movements which are inevitable in the voluntary exercises commonly prescribed directly bring about a looseness of the cartilage in the cases which originally are merely bruises or lacerations of

attachments only, and in those which originally were displacements they tend to produce recurrence of the condition more certainly than any other means. It would be easy to give many examples in illustration of this point, but the one which follows will suffice.

A soldier, aged forty-two years, had an undoubted displacement of the left internal semilunar cartilage: this was replaced soon after the injury by the practitioner who was at first consulted, and the ordinary exercises of the gymnasium were at once prescribed. At the end of a week the displacement recurred; the pain was intense, complete extension being impossible; reduction was attempted but apparently without success, as no change in the condition of the limb followed. The exercises were continued and as much walking as possible was recommended. Six weeks later I saw the patient: the leg was then considerably flexed and could not be extended by manipulation; the knee was distended and the pain on walking was acute. Rest for a fortnight with massage without exercise removed the fluid, and reduction occurred spontaneously whilst turning in bed. Recurrent attacks followed, and ultimately I removed the portion of the semilunar cartilage concerned. Not more than half an inch of the anterior end was detached, and I am strongly of opinion that if the case had been treated upon the lines which I recommend no operation would have been necessary.

The object of the temporary fixation and massage is first of all to remove the fluid, and secondly to allow the loose portion of the cartilage to fall back and adhere in its normal site, which, with the help of the surrounding inflammation which almost always follows to some extent, it will generally do. The passive movement without rotation, whilst it does not disturb in any way the process of refixation, prevents any troublesome adhesion in the joint itself.

It is interesting, perhaps, to mention here, with reference to what has just been said about the effect of inflammation in the refixation of a loosened cartilage, that, so far as my experience goes, the cases in which the inflammation following immediately upon the injury is somewhat acute show less tendency to recurrence of symptoms, when the condition is adequately treated, than those in which the immediate inflammation is very slight or non-existent, which, if my view of what occurs is correct, is precisely what would be expected. At the end of a fortnight pedal exercises may be freely used, the massage being continued, and at the end of three weeks from the date of injury the patient, who has up till then been walking with a 'stiff leg,' begins ordinary walking exercise. The time during which the massage must be continued varies in different cases from three weeks to six months or possibly more. The time for its cessation is determined by

the condition of the thigh muscles and of the *capsule of the joint*. Speaking generally, it may be said that in no case can it be considered safe to dispense with the treatment if the thigh muscles remain wasted or if the capsule is lax, the latter condition, which is practically dependent on the former, being the more important, as the lateral movement or 'wobbling' of the joint which is associated with it is directly conducive to recurrence of the trouble in the articulation.

The importance of restoring the proper tone or tension of the capsule of the knee-joint in these cases is, I believe, not sufficiently appreciated, nor do I think the means of effecting this end are altogether a matter of common knowledge. It is too commonly known, I suppose, to need emphasis here that the normal tension or 'tone' in the capsule of the healthy knee is greatly dependent upon the muscles in the thigh proper which send expansions to it, notably the quadriceps extensor. A factor, however, of prime importance in this matter is one which, judging from the way in which the treatment of these cases is frequently conducted, is not always held in sufficient esteem—I mean the ilio-tibial band the elastic tension of which is upheld by the gluteus maximus and the tensor fasciæ femoris. It will be found in the majority of, if not in all, cases like those now under discussion, when the knee capsule is very

lax and the lateral movements of the knee are excessive, that there is marked wasting of these two muscles. Although much attention is generally paid to the wasting of the quadriceps extensor and to attempts at the restoration of its normal condition, I do not remember having seen attention called to the wasting of the muscles connected with the ilio-tibial band. The practical importance of this point to which I particularly wish to direct attention is this:—In attempting the restoration of the normal tension of the knee capsule by massage and exercises the treatment must not be limited to the obviously wasted muscles in the thigh—the quadriceps extensor, for example—but should be applied with equal vigour to the muscles connected with the ilio-tibial band, the gluteus maximus, and the tensor fasciæ femoris. The method which I have given in detail is that which I have come to believe to be best for the management of the cases now in view if a cure in the true sense is aimed at. I am well aware that in many instances the method must be too expensive, and possibly, from the patient's point of view, too tedious to be practicable. Such cases should be managed with as little modification of the plan described as circumstances allow, the essential points of the immediate treatment—viz. temporary rest for the joint and avoidance of rotation movement—being especially borne in mind.

2. *Treatment by the use of apparatus.*—On this head little requires to be said. No support or apparatus of any kind should be employed unless absolutely unavoidable ; moreover the use of instrumental support of any kind in the case of a patient whose treatment has been commenced immediately after the receipt of the original injury must, excepting in a few special circumstances, be held to be sure evidence of the failure of the treatment primarily adopted. It cannot be too strongly emphasised that the use of artificial supports always tends to render permanent the wasting of the thigh muscles to an extent which varies in degree with the kind of instrument employed. The cases in which the use of supports is justifiable are limited as follows: (1) cases in which for unavoidable reasons the rational treatment cannot be carried out; (2) cases in which the rational treatment fails to restore the normal tension of the knee capsule or those in which abnormal lateral mobility remains to any marked extent in spite of the treatment; and (3) cases in which recurrent attacks of semilunar displacement have occurred frequently, operation having been for some reason rejected. When the symptoms point with reasonable certainty to the existence of a loose body other than a displaced cartilage the use of a support is obviously futile, operation being the only method which offers a prospect of relief. In the

event of the use of a support being, for sufficient reasons, decided upon it is of importance that it should be constructed on proper principles. All the ordinary 'knee-caps,' whether of elastic or inelastic materials, are to be avoided, as, whilst not in any sense providing the means for acquiring the desired

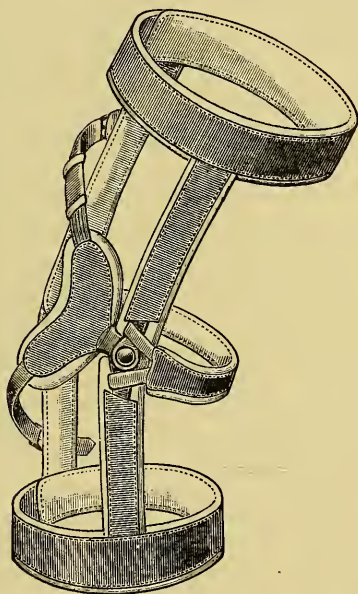


FIG. 10.—SPRATT'S INSTRUMENT FOR CASES OF DISPLACED SEMILUNAR CARTILAGE

The kidney-shaped pad is not, as a rule, required—the utility of the instrument depends mainly upon accuracy in the fit of the thigh and leg girdles

end, they tend more than any other contrivance to increase and perpetuate the wasting of the thigh muscles.

The object to be attained by artificial support is the prevention of rotation of the leg at the knee; to reduce, in fact, as much as possible the knee to the

condition of a true hinge. In the manufacture of these instruments this salient point is the principal factor to be kept in view. It is too often thought that a truss or pad may be made by the pressure of which a semilunar cartilage can be kept in its proper site. A moment's consideration will show that this is impracticable, especially in the face of the fact that in these cases of loosened semilunar cartilage the displacement is generally inwards towards the articulation—a direction in which an external pad could by no amount of ingenuity be made to bear. All that can be accomplished by properly devised instruments is the gripping of the head of the tibia with a view to the prevention of rotation; and I am acquainted only with two appliances which reasonably effect this purpose, one being complicated and expensive, whilst the other is comparatively simple and inexpensive.<sup>1</sup> So far as the effect is concerned I do not know that the one is better than the other. The small spring 'trusses' sometimes supplied are entirely useless.

### THE OPERATIVE TREATMENT.

With regard to the propriety of the removal of displaced or loosened semilunar cartilages there

<sup>1</sup> These instruments, which are made by Ernst and Spratt respectively, are both excellent; that which I have found most generally useful is shown in fig. 10.

appears even now to be some divergence of opinion ; for whilst some surgeons—the majority I suppose—think removal the only practical plan of treatment in certain cases, others adopt the opposite extreme and incline to reject the operation altogether ; indeed some appear to think it an unjustifiable mutilation. For my own part I believe that no operative measures in these cases short of removal of the offending cartilages is efficient, and there is no doubt that if necessary the cartilage can be removed with advantage ; indeed, in some cases its removal affords the only possible means of providing a workable joint, and I have certainly seen no reason to believe that any defect in result after operation arises from the mere absence of the cartilage. At the same time I am of opinion that the percentage of cases in which operative measures of any kind are necessary in cases presenting the recognised train of symptoms should be very small indeed if the original treatment has been properly managed. Under ordinary circumstances I am sure that operative measures should, speaking generally, be postponed until all other treatment has failed to satisfy the patient. If the original treatment is rationally conducted I further believe that operations in these cases would be found to be limited for the most part to the removal of pedunculated bodies and synovial folds. The semilunar cartilages would rarely require operative interference.

The fact that it is practically impossible, excepting in those unusual instances in which the cartilage can be felt to be absent from its normal site, to determine what is the real cause of the trouble in these cases without opening the joint renders exploratory operations in intractable cases obviously desirable; but having regard to the large percentage of cases which are curable without operation the explorations should in my opinion be reserved for (1) cases in which non-operative measures have conclusively failed to cure or sufficiently modify the symptoms to satisfy the patient; (2) cases in which general flaccidity of the joint, as shown by an abnormal amount of lateral movement upon manipulation, is in excess of the other symptoms (I have already indicated the important part which this flaccidity plays in the ultimate result of the treatment of these cases, and the strongest indication for exploratory operation is afforded, in my opinion, by progressive looseness of the joint generally. It is at the same time well to note that these loose joints, especially if the lesion involves the semilunar cartilage, are those in which the tendency to defective results is strongest); (3) cases of expediency in which an early attempt at relief is urgently called for by special circumstances, such, for example, as may be the case with a soldier or any person in the public services to whom the persistence of a physical defect

may entail the relinquishing of his career, or in the case of gymnasts and the like; and (4) grossly neglected cases in which from long-continued inflammation the joint has assumed the aspect of pulpy disease. Such cases are, however, rare, and, indeed, in the true sense are outside the category both clinically and from the operative aspect of those now being discussed.

It has recently been stated that the large majority of cases of tuberculous disease of the knee in adults arise from injury to the semilunar cartilage. It is, however, extremely difficult to see upon what evidence such a view can be based when the extreme difficulty which exists in the diagnosis of injury of the fibro-cartilage is borne in mind. From my own experience I see no reason, after very careful observation, for thinking that tubercle of the knee follows more frequently upon injury of the fibro-cartilage than of other constituents of the joint; indeed I should say that injury of the fibro-cartilage as a forerunner of tubercle is the exception, and is probably rare.

The reasons for restricting operative treatment to such a comparatively small number of cases are the following: (1) The vast majority of these cases are, I believe, curable by the means already indicated, and of the remainder many, although not curable in the true sense, can with or without suitable apparatus be made of so little inconvenience that the majority of patients are too well content with their

condition to submit to the inconvenience, accidental risk, and expense of an operation the result of which may, after all, be disappointing. (2) The operative measures necessary for dealing with these cases when the semilunar cartilage is the structure at fault cannot be regarded as entirely free from risk. It is, I believe, a fact that although opening the knee-joint for the removal of loose bodies or synovial folds is rarely, if ever, followed by anything but uneventful recovery in competent hands, the removal of a semilunar cartilage is by no means so free from subsequent trouble as is generally imagined, or as would be concluded from a perusal of recorded cases, and I cannot but believe that if the results of all the cases operated upon in London in the course, say, of any five consecutive years could be forthcoming the general estimate of this operation would be lower than it at present is. Although up to the present time I have had no disaster after opening the knee-joint with the exception of one instance, in which direct septic infection occurred from accidental causes entirely beyond my control in a case not included in the series now under consideration, because it was of a different kind, I must admit that two of the present cases were the cause of much anxiety. The temperature charts of these cases are appended: no suppuration occurred and no active measures were necessary; but it would be idle to

deny that during the periods covered by the charts these patients were in a somewhat critical condition so far as the utility of the joint (and perhaps the

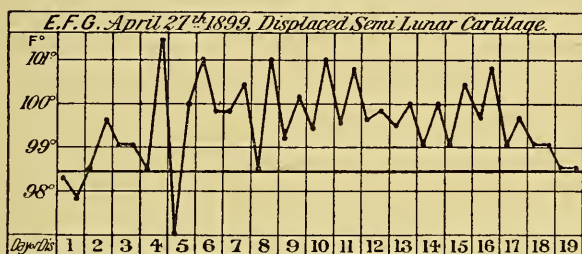


FIG. 11

integrity of the limb) was concerned. It is at the same time noteworthy that the results of these cases ultimately proved to be the most perfect of the series

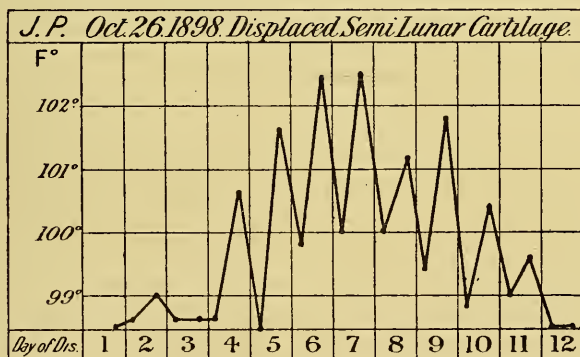


FIG. 12

of those subjected to operation. Under any circumstances, however, the risks are, of course, comparatively small and mainly accidental, but they are, I

submit, sufficient to merit consideration in the discussion of the pros and cons of this operation, which I venture to think is occasionally too lightly undertaken. (3) The results of operation are not always perfect. Apart from cases in which failure is complete—viz. those which end in a completely stiff joint or possibly the loss of the limb—there is undoubtedly a certain percentage of failures from (1) recurrence of the symptoms and (2) partial stiffness of the joint. Of the general proportion of these failures it is of course impossible to acquire accurate knowledge; but in my series of *removal* of the semilunar cartilage recurrent symptoms occurred in one only and some slight limitation of movement also in one; whilst in two cases in which the cartilage was *fixed by sutures* the symptoms recurred in less than a year from the time of operation.

It is conceivable that it may be submitted, and indeed I have heard it suggested, that in exaggerated cases, even if a stiff limb results after operation, the patient's condition is not only no worse, but really better than before. Admitting, for sake of argument, that this may be so in some cases, it cannot be urged that the result is anything but a failure in the case of an operation performed with the express object of providing a normal joint. To deliberately produce by operation a stiff limb may in some of the cases be proper enough under certain circumstances, but to regard a stiff limb as a satisfactory result of an

operation performed with the sole object of giving a freely movable joint is hardly rational.

With regard to the method of operating I have found the vertical incision (converted, if necessary, into an L shape) all that is requisite to give access to the part; and I confess that I am at a loss to understand the reason for the extensive transverse incision, including of course the division of the patella, which is now advocated by some. The operation performed in this way seems to be unnecessarily severe, and must, *cæteris paribus*, tend to interfere more with the subsequent perfection of the joint than the simple longitudinal incision could possibly do. Moreover, so far as I have seen, no very extensive exposure of the joint is necessary in these cases: the localised symptoms indicate very clearly the seat of the trouble which is readily accessible through a moderate incision.

Although I rarely use drainage tubes or drains of any kind in operations, I have come to believe that a drain for 24 hours is advantageous in all cases in which the knee-joint is opened. The pain is certainly less when a drain is used, and the distension from subsequent effusion which sometimes gives trouble is obviated; passive movement is also tolerated earlier—a very important point. Indeed from all points of view it is, I think, safer and more satisfactory to use a drain for 24 hours.

In the case in my series in which after removal

of the offending structure recurrent symptoms occurred it was suggested that the recurrence was due to some fold having escaped notice in consequence of the exposure of the joint cavity having been insufficient; but at the second operation it was clear that this was not the case, as the cause of the recurrent symptoms was a growth of tissue into the joint from the line of the division of the synovial membrane at the previous operation.

There can, I think, be no doubt that the success of the operation depends more upon the management of the case before and after the treatment than upon any special method of operating. The following plan of management will, I believe, be found to produce the best results; it was used in all the cases now mentioned excepting that in which some limitation of movement occurred. The patient is kept in bed for a week prior to the operation, daily massage without passive movement is used, and no thought of operation is entertained until all fluid in the joint has disappeared. To operate in the presence of fluid in the joint is, I am sure, reckless. Upon the day following the operation, unless pain or other unforeseen conditions are contra-indicative, massage of the limb generally, above and below the knee is commenced, the dressings of course being left undisturbed. Gentle passive movement of the patella, in order to prevent it becoming in

any way fixed, one of the most important points in the subsequent progress of the case, is commenced not later than on the fourth day, the outer dressings being if necessary removed daily for this purpose. At the end of a week passive movement of the knee is generally commenced, and can, as a rule, in ordinary cases be carried out by the patient, the splint being removed for a short time daily. To the constant use of skilled muscle massage I attach great importance for reasons already discussed in connection with flaccidity of the joint capsule, upon the presence or absence of which depends to a very large extent the failure or success of the case. In connection with the progress of the cases after operation, when the semilunar cartilage itself is dealt with, an interesting point is afforded by the variability in the course of the cases during the first week which in the majority is unattended by pain or discomfort of any kind, there being neither effusion nor other objectionable development. On the other hand, pain with or without effusion in some cases is intense, the temperature at the same time perhaps rising to a serious degree. I have rarely, I think, seen more severe pain than that suffered by one of my patients, although the joint did not become tense and the temperature did not reach a higher point than  $99.2^{\circ}$  F. In two other cases the pain was extreme, indeed almost intolerable; in each

of these some tension of the joint arose, the effusion in each commencing at some time during the third day. The bulk of this pain seemed to be due to, or at all events to be greatly increased by, muscle spasm, or cramp both in the leg and thigh, which could only be relieved by gentle smooth massage during which the patient would often fall asleep. It is perhaps worthy of note that the cases in which these apparently unfavourable symptoms developed produced ultimately the most perfect results which I have had, the joints in all being finally perfectly normal in every sense of the word. This effusion coming on several days after the opening of the joint must, I assume, be due to inflammation and I am inclined to think that a certain amount of inflammation provided, of course, that it subsides before harm is done, is advantageous, as it is not unlikely that the inflammatory process may tend to fix any loose parts in the operation area which in the absence of inflammation may by reason of their looseness give rise to recurrent symptoms. In this connection it is significant that of all my cases the one which made the most rapid and perfect progress, so far as absence of discomfort was concerned, was that in which recurrent symptoms followed upon the removal of the anterior two-thirds of the left internal semilunar cartilage.

In conclusion, it is fair to allow that, having

regard to the admitted comparatively slight risk of these operations and the impossibility of determining with certainty the conditions at fault in the majority of these cases without opening the joint, it may be with reason submitted that a more rational plan than reserving the operation as a last resource, or at all events postponing it until other means have failed, would be to first perform the exploratory operation and then proceed with the treatment indicated by the circumstances revealed. My objections in this connection are mainly two. In the first place I do not think that the measures at our disposal are sufficiently certain to admit of the performance of these operations with entire impunity, and in the second place I cannot admit that the possibility (thanks to the antiseptic system) of operating without risk other than that which may be regarded as accidental is in itself any justification for the performance of operations in cases in which there is certainly a good chance in the majority of attaining the end in view without operative interference. This latter aspect of the question is, I believe, worthy of special consideration at the present time, when I cannot help feeling that the tendency to reduce the practice of surgery to what is little more than a mere handicraft is somewhat too strong.



## APPENDIX

### *ON THE USE OF MASSAGE IN THE TREATMENT OF RECENT FRACTURES.<sup>1</sup>*

THE use of massage in the treatment of recent fractures, although it may have been adopted by a small number of individual surgeons, does not appear to have received the general attention in this country which in my opinion it deserves. No apology is therefore offered for the following communication, as, so far as my experience goes, the results in suitable cases seem likely to be better than those obtainable by any other method with which I am acquainted. In my trial of the treatment I have had the advantage of the help of Doctor Hamel, who has had much experience in the matter. He was good enough to come to St. George's Hospital to personally manage some of the earlier cases and instructed my dressers as to the details of the method.

The reason that this treatment has not been generally received with more favour here seems to be mainly the traditional belief in the necessity for complete rest and immobility in the affected limb which does not at first sight appear consistent with the employment of massage. The fact that massage does not necessarily entail material movement between the fractured bone ends although the muscles about them may be freely moved appears to have been over-

<sup>1</sup> Reprinted from the *Lancet*, February 5, 1898.

looked by those who either disapprove of, or are sceptical about, the method. Massage in any ordinary case of recent fracture, if properly applied, can be used without producing any movement between the bone ends worth mentioning, and in the most difficult cases the amount of movement in the fracture itself is not sufficient to delay union, for union I believe occurs, *cæteris paribus*, more rapidly in cases treated by massage than in those treated by conventional plans. Indeed, it is permissible to raise the question whether under any circumstances slight movement between the fragments in cases of fracture, provided that the position of the parts is good, is not rather conducive to union than the reverse when it is remembered that in many cases of fracture in which the union is slow consolidation rapidly takes place when some mobility between the bone ends is brought about either by encouraging the use of the limb by the patient or by passive movements.

I presume the experience of the majority of surgeons coincides with mine in showing that the most troublesome part of the management of very many cases of fracture, especially those of the lower part of the leg, is connected with the stiffness, pain, and difficulty of movement which follow upon the discontinuance of the splints when the fracture is treated in the usual way, rather than with any initial trouble in 'setting' the fracture or in its early progress. Although it is true that in the majority of cases the pain, stiffness, &c., can be overcome by perseverance on the part of the patient, by prolonged massage, or by forcible breaking down under an anæsthetic, it is an undeniable fact that in not a few instances the tendons and soft parts become so firmly matted together that the stiffness and pain are practically unmanageable and lead to permanent crippling, which will vary in degree according to the circumstances of the case. The usual method of treating fracture by prolonged

retention of the affected limb in splints which allow of practically no movement of the soft parts about the fracture directly tends to this matting process and leads to a large percentage of the unsatisfactory results which follow upon fractures, especially in the vicinity of joints. The stiffness and pain which follow in many of these cases are often erroneously attributed to adhesions in or about the joint only or to some slight faulty position of the fractured bone. In reality the defective movement is, I believe, nearly always due to matting of the soft parts immediately about the line of fracture. How firm this matting of the parts may be and the degree of stiffness which may thus be caused are fairly shown by the state of affairs found in the dissection of a fracture of both bones in the leg three inches above the ankle, the injury, judging from the condition of the union, having been received about two months previously. The fractured parts were firmly united, and the position of the fragments, although not perfect, was fairly good. No movement beyond a little 'springing' in the ankle joint could be produced by violence such as is ordinarily used in the 'breaking down' of joints. The ankle-joint was healthy and the stiffness was entirely due to the state of the soft parts about the fracture. The anterior tibial muscle at the point of junction with its tendon was firmly adherent to the bone; the muscular structures at the posterior aspect of the fracture had apparently been slightly torn, and were with their tendons intimately adherent to the bone by cicatricial tissue, in which the posterior tibial nerve was involved and could only be liberated by careful dissection; the nerve showed no sign of having been damaged at the time of the accident. All movement in the ankle-joint beyond that allowed by the mere elasticity of the parts appeared to be checked by the adhesion of the tissues mentioned. When the adherent structures had been

loosened by dissection the ankle-joint could be freely bent with comparative ease. The implication of the posterior tibial nerve is interesting, for it affords a ready explanation of the acute nerve pain caused by attempts at movement of the ankle-joint in walking after some cases of fracture about the lower part of the leg.

In the treatment of cases of recent fracture by massage this matting of the soft parts is impossible; the tendons are prevented from becoming adherent, the muscles do not waste, the joints are kept supple, and nerves cannot become implicated in adhesions. It therefore follows that upon the patient resuming the use of the damaged limb the joints are as freely movable as if no fracture had occurred, the muscles are well developed and comparatively strong, and the neuralgic pain so often met with under ordinary circumstances is wanting. Indeed, with the exception of any shortening or deformity which may be the immediate outcome of the fracture the limb is, in ordinary uncomplicated cases, practically as sound and healthy as that on the opposite side. This condition of things, when compared with the state of the limb upon the removal of the splints in a case treated by the usual method of immobility, is in itself, I venture to submit, sufficient to entitle the massage method to a fair claim as a routine treatment in a large number of recent fractures. There are, however, other reasons in favour of its adoption. Nothing tries the endurance of the patient and the resources of the surgeon more than the distressing muscular spasm which so often occurs in the early stage of cases of fracture, and which, in spite of anæsthetics and minor operations (tenotomy &c.), is in some instances practically uncontrollable until it 'wears itself out' in the course of some days. In massage there is, it seems, at hand a means by which this spasm may be frequently, if not always, controlled in a way which to

those who have not seen the effect is remarkable. A good example of this is the following. A very feeble old woman was sent to St. George's Hospital with a comminuted fracture about the middle of the right femur. The injury had been received two days previously, the fracture was greatly displaced, and the limb was tense, swollen, and discoloured. It was quite clear from the condition of the limb that any immediate attempt at extension or the application of splints was out of the question; she was therefore placed in bed with the limb arranged as comfortably as was practicable between pillows. The muscular spasm, both before and after her admission into the hospital, was extreme, and in spite of narcotics prevented any appreciable amount of sleep. I saw the patient the day following her admission: she was suffering greatly, and every few minutes shrieked as the muscular spasm occurred. In spite of the threatening appearance of the limb generally, and in spite of the slightest attempt at extension setting up intense pain from spasm, massage over the fracture was commenced at once. At the end of ten minutes the spasms were much less, and in a quarter of an hour had subsided altogether, so much so that the old woman fell into a sound sleep whilst the rubbing was being done—the first sleep she had had for three days. After this she constantly begged for the rubbing, as it stopped her spasms, which rapidly disappeared altogether and allowed the limb to be manipulated freely. All swelling excepting immediately about the fracture soon subsided, rapid union followed, and in three weeks, the massage having been regularly applied, she was strong enough to allow of her 'lying outside her bed,' no splint of any kind having been used.

In another case in the same ward, in which there was a fracture of both bones of the leg, acute muscular spasm, in spite of anæsthetics and every possible care, entirely prevented

my keeping the fragments in anything like reasonable position. Any cutting operation for the purpose of wiring the fracture was for sufficient reason negatived; so I tried the effect of massage, with the result of entirely allaying the spasms, thus making it possible without any difficulty to retain the fracture in the best position allowed by the circumstances of the case, which was quite impossible before the massage was used.

This soothing effect, although remarkable, seems to be the rule, and patients otherwise restless constantly fall asleep while the treatment is in actual progress. The effect upon the bony union appears to be to hasten the process of consolidation, probably, I suppose, in consequence of the better circulation which is produced in the part, with the resulting improvement in nutrition. This is especially the case in subjects getting on in years.

The technique of the treatment is very simple, and is easily acquired by any person of ordinary intelligence possessing a light hand and fair sense of touch, gentleness being the keynote to successful manipulations. The method comprises three stages: 1. Gentle rubbing in an upward direction over the fracture with a view to soothing the patient, the relief of muscular spasm, and the rapid absorption of extravasated blood &c. 2. Passive movements of the joints above and below the fracture (thus effecting 'internal massage'), by which all matting of the soft parts at the seat of fracture and about the joints is prevented. 3. The development of wasted muscles by the ordinary massage processes. The details of the method used in my cases will be best understood by describing an ordinary straightforward case of fracture of both bones of the leg three or four inches above the ankle in which there is little or no difficulty in keeping the bones in fair position. Reduction of any displacement of the fragments having been accomplished, the limb is placed upon a back-

splint reaching above the knee with a foot-piece to which the foot is fixed by bandage in the usual way, care being taken to include no more of the leg above the ankle than is absolutely necessary ; a second bandage or piece of webbing fixes the limb to the splint just below or at the knee. As much as possible of the area of the fracture should be left exposed. Rubbing by a gentle smoothing movement upwards from the ankle is now made by the flat of the hand, grasping as much of the circumference of the limb as is possible. However tender the parts may at first seem, no pain will be caused, but, on the contrary, a soothing effect is rapidly produced. Ten minutes of this rubbing is sufficient at the first application. If at the end of this time the patient is fairly comfortable the toes are taken altogether between the operator's thumb and fingers and very gently extended upon the metatarsal bones two or three times. At the end of each rubbing side splints or sandbags are used in addition to the back splint for the better steadying of the fracture. This proceeding is repeated daily, or oftener if practicable, for from four to seven days, the time occupied by each massage being gradually increased to twenty minutes or more (the side splints being removed before the commencement of each rubbing and afterwards replaced). At the end of this time if the fracture is in good condition and the fragments show no sign of altering their position the bandages are removed from the foot and ankle leaving the limb exposed and lying on the splint. The smooth rubbing already described is now applied over the foot, ankle, and leg, for about ten minutes, and then, without removing the limb from the splint, the operator gently flexes the ankle two or three times or more on the leg with one hand whilst he steadies the fracture with the other, the bandages being afterwards replaced as before. This is repeated daily for three or four days, after which the limb at each sitting is

gently lifted off the splint on to a flat pillow ; the rubbing is now more thoroughly done and the passive movements of the ankle more freely carried out, the fracture being of course still supported with one hand of the operator ; at the end of each sitting passive movement of the knee is now added. The passive movement of the ankle must, of course, be commenced very gently, as some slight pain may be caused by the 'internal massage' resulting from the working of the tendons and muscles in immediate relation with the fracture itself. At the end of another week the union is usually firm enough to allow of all the manipulations of ordinary massage, and the patient may be encouraged to move the ankle spontaneously as freely as possible, the fracture being fixed with some form of short splint. The complete massage should be continued until the union has fairly consolidated ; the period necessarily varies in different cases, but in a simple uncomplicated case of fracture of both bones of the leg a month is the approximate time. For the first fortnight the patient is better confined to bed ; after that he may lie on the sofa and generally be allowed to get about with crutches, in which case a moulded poroplastic or leather splint, made so that it can be easily removed for the massage sittings, may be desirable. The above description must be taken to apply merely to a straightforward case without complications ; it is sufficient to indicate the main points connected with the technique of the treatment.

In some cases in which the lesion is very near to or actually involves the joint the treatment is obviously more difficult and requires great care. In Pott's fracture, for example, it is necessary to uncover the ankle from the commencement for the application of the primary rubbing and the passive movement—a most important point. The management of this particular fracture has to be conducted with much discretion. A minor but much appreciated benefit afforded

by the method of treatment is the comfort which the patient derives merely from frequent temporary release from the restraint imposed by the continued use of splints. The degree of this comfort can only be fully realised by those who have to submit to the cramping and immobility of the limb necessarily entailed by the treatment by splints commonly adopted. The objections to the method which may be raised are, so far as I know, of no moment surgically, but it is idle to deny that certain difficulties connected with its employment exist which must, I fear, prevent its becoming general in the ordinary sense of the word. This, however, does not of course minimise the value of the treatment when the means for its application are available. At first sight the use of passive motion by which the soft parts above the fracture are prevented from becoming adherent may appear objectionable, since in a large number of cases these parts must necessarily be more or less torn. The early movement of the torn structures may seem likely to produce weakness. In practice no defect of this nature appears to be brought about if ordinary care be taken in the application of the treatment; and if it be granted for a moment that some weakness in the more severe cases may possibly arise it would certainly be far less detrimental to the patient than the crippling which ensues upon any extensive matting of the torn structures.

An objection which may arise in connection with hospital cases is the necessity, when fractures are treated by the massage plan, for a longer residence in hospital than would be necessary in many cases which might be put up immediately in some kind of splint (silicate, poroplastic or leather) which would enable the patient to be discharged at once or very soon after the accident. This objection would carry more weight with some surgeons than others. Personally it does not much concern me, as I have never looked with

very great favour upon the immediate use of splints of plaster of Paris, silicate of potash, and the like, in any but cases of the simplest kind, as I have seen enough of the disadvantages of the plan to lead me to reject it, as a rule, in the severer cases. Apart, however, from the difference in the custom of individual surgeons in this connection there must under any circumstances be a considerable number of fractures, at all events of the lower limbs, which require detention in hospital for some time. It is safe to say that almost all of these cases can be treated by the massage method either in its entirety or with some modification. In private practice the objection now under discussion may or may not be considered of importance. In my opinion the advantage derived from the method when properly applied outweighs the disadvantage of the necessity for retaining a patient in hospital for ten days or a fortnight longer than would be necessary if the fracture were treated immediately by some form of immovable splint, the results of which are by no means always satisfactory and are sometimes disastrous. The difficulties connected with the application of the treatment which must necessarily more or less interfere with its general adoption are principally two: (1) The large amount of time required of the practitioner in the earlier stages of the cases during which the treatment must be carried out under his immediate supervision unless a particularly skilled person is available (in some of the severer cases the treatment at first, at all events, could hardly be managed by any one but the practitioner himself); and (2) the difficulty of finding in all places a person capable of safely undertaking the manipulations in the later stages, which would absorb more time than any busy practitioner could afford as a rule to give. Other minor difficulties, such as expense, might arise, but are not of sufficient interest to require comment here.

In conclusion I hope I need hardly say that I have no desire to overstate what I regard as the advantages obtainable by massage in recent fractures. My main object is to induce those surgeons who have as yet no experience of the method and who have the means at hand for its employment to give it a trial. It is, as I have said, a method from which I have obtained what I believe to be sufficiently good results to make it worthy of adoption in the generality of cases in which the surroundings of the patient and the circumstances of the practitioner render it feasible, and I shall be surprised if those who have already had experience of it, or are now induced to try it, do not agree with me in this opinion.

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